Morphometric analysis of acetabular rim shape among ancient Mongolian pastoralists

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Introduction

The adoption of nomadic pastoralism may have marked new physiological stresses to the hip for the bipedally-adapted human rider. Relatively few studies have examined differences in acetabular shape resulting from long-term equestrianism [1, 2]. Steppe populations of Mongolia began a nomadic pastoral lifestyle during the Late Bronze Age, which has persisted to the present day, with whole communities of men, women, and children riding horses as part of their lifeway.

Materials and Methods

Three-dimensional laser scans captured morphometric data of os coxae of pastoral samples (n=34) from the National University of Mongolia. Samples date from four periods, spanning incipient pastoralism in the Bronze Age to the later Mongol Period (Table 1, Figure 1). To determine whether acetabular shape among pastoralists is distinct, these pastoral data are also compared to scans of 20th century “White” Euro-American samples from the Hamann-Todd human (HTH) osteological collection (n=20).

Scan Data Analysis

CloudCompare (v.2.3), an open source 3D point cloud processing software, was used to: 1) trim points—as close as possible within the same plane—to the acetabular rim (Figure 3); and 2) obtain radius distance of this rim. These data were analyzed for the shape of the acetabular rim relative to a best fitted cylinder.

Results

Within the Mongolian sample there are no significant differences between subadults and adults in acetabular rim shape, nor between males and females (both adolescent and adult comparisons) (Table 2).

Discussion and Conclusion

These results suggest the acetabular rim shape does not change significantly as a result of long-term horse riding. Within the Mongolian samples there are no significant differences among men, women, and subadults, but historical accounts note the young starting age of riding among Mongolians of both sexes [3, 4], which may explain these results. The Scythian sample may be distinct from the other periods (and HTH) since they were a western nomadic group that may have had a different riding style, and possibly different genetic heritage and associated hip morphology. What is surprising is the lack of distinct differences between the Mongolian samples and the 20th century collection, which comprise different genetic and activity profiles.

Statistical tests

Independent samples t-tests were conducted to compare samples by age (subadult-adult) and sex, within and between Mongolian and HTH samples. One-way ANOVA tests compared the different periods within the Mongol sample and to the HTH sample, with post-hoc LSD tests to determine which conditions were significantly different. All tests were run with SPSS v.18.

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