INTRODUCTION
Osteoarthritis (OA) of the hip is an important cause of pain and morbidity. Hip OA is a complex disorder with multiple genetic, environmental and constitutional risk factors contributing to its development and phenotype. Although OA has marked familial predisposition, the mechanisms and pathogenesis of its development remain unknown. Minor acetabular dysplasia and subtle variations in proximal femoral morphology are increasingly being recognized as factors that potentially compromise the joint biomechanically and lead to OA. Cross-sectional case control studies have shown that risk of hip OA increased as the femoral head-to-femoral neck ratio (HNR) decreased. Previous studies have described the evolutionary change in inferior femoral neck trabecular density and geometry associated with upright stance, but no study has highlighted the evolutionary change in HNR. The aim of this study was to establish whether there is any evolutionary evidence that the hominin, bipedal stance has lead to alterations in HNR that would predispose humans to hip OA.

METHODS
A collaboration with The Natural History Museums of London, Oxford and the Department of Zoology, University of Oxford provided specimens from the Devonian, Triassic, Jurassic, Cretaceous, Miocene, Palaeolithic and Pleistocene periods to modern day. Specimens included amphibian reptiles (e.g. Hellbender), dinosaurs, shrews, tupaias, lemurs, Africangroundapes, Lucy (A. Afarensis), Turkana Boy (H. Erectus), H. Neaderthalis and humans. Species were grouped according to gait pattern; HAKF (Hip and knee flexed), Arboreal (ability to stand with hip and knee joints extended) and hominin/bi-pedal. Imaging of specimens was performed using a 64 slice CT scanner. Three-dimensional skeletal geometries were segmented using MIMICS software. Anatomical measurements from bony landmarks were performed to describe changes in HNR, in the coronal plane, of the different specimens over time using custom software.

Measurements of HNR from the specimens were compared with HNR measurements made from AP pelvic radiographs of 119 normal subjects and 210 patients with known hip OA listed for hip arthroplasty.

RESULTS
Species from the HAKF group that ambulate via sprawling had the smallest HNR (1.10, SD: 0.09) (p<0.001). Species of the arboreal group, that mainly ambulated by jumping in-between trees had the biggest HNR (1.63, SD: 0.15) (p=0.006). The first bipedal (1.41, SD: 0.04) had significantly bigger HNR (p=0.04) in comparison to the normal human subjects (1.33, SD: 0.08). The lowest HNR was observed in the OA group (1.3, SD: 0.09).

DISCUSSION
The adoption of an upright stance during evolution has created an associated change in the femoral neck bone stock to adapt to the altered loading environment. These data would suggest that the HNR peaked in the Miocene period (10-15 million years ago). The trade-off between mobility and the bony density required to support gait has lead to a decreasing HNR throughout hominid evolution. Evolutionary theory would suggest that modern environmental pressures might pre-dispose future hominid evolution to an increased risk of hip OA.

REFERENCES:

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