In conclusion, there are marked variations in the hardness of bone in the femoral neck, both between osteonal and interstitial bone and between cortical regions subjected to varying habitual strain modes. Bone habitually loaded in compression (I) was harder than that loaded in tension (S), and interstitial bone was harder than osteonal bone. Finally, hardness was lower in the anterior regions of the cases of hip fracture for both bone types, and lower in the inferior for osteonal bone, associated with increased remodelling.

Disclosures: ***E. Follon****, None.*

SU312

Periosteal Bone Turnover at the Femoral Neck in Non-Human Primates. M. Bliziotes[1], J. Sibonga[2], R. Turner[2], E. Orwoll[1]. [1]Oregon Health and Science University, Portland, OR, USA, [2]Mayo Clinic, Rochester, MN, USA.

Bone size is an important determinant of bone strength, and modeling at the periosteal surface alters bone dimensions in adults as well as during growth. Nevertheless, periosteal biology remains poorly understood.

Therefore, the proximal femurs of 16 adult non-human primates (Rhesus (Macaca mulatta, n=9) and Japanese Macaque (Macaca fuscata, n=7)), were analyzed after double-labeling with two discrete intervals of tetracycline (250 mg bid for 3 days separated by a 14 or 15 day interlabeling period). Necropsy was performed 2-7 days following the last administration of tetracycline. Histomorphometric measurements of fluorochrome labels and of stained sections complied with standardized procedures, formulae and nomenclature. Statistical comparisons between multiple groups were analyzed by 1-way ANOVA followed by a Fisher PLSD post-hoc test after determination of significance.

Both bone resorption and formation were present on the femoral neck periosteal surface. Multinucleated, acid phosphatase positive osteoclasts were present in typical Howship's lacunae. This osteoclastic activity was not the result of the emergence of intracortical tunneling at the bone surface. The periosteal eroded surface of the femoral neck was significantly greater than in the marrow compartment ($p<0.0001$) or on the femoral shaft periosteum ($p<0.0001$), although osteoclast number was similar at all three surfaces. Mineral apposition rate on the periosteal surface of the femoral neck was greater than on the shaft but less than on cancellous surfaces. Femoral neck periosteal bone formation rate was 2.5% of tissue volume per year, approximately 10-fold more than observed in the femoral shaft.

Thus, not only have we documented intramembranous periosteal bone formation in the femoral neck in a series of non-human primates, we have also found that the tissue level bone formation rate was sufficient to add substantively to femoral neck size over time. We also documented active periosteal bone resorption at the femoral neck. The turnover rate in the femoral neck periosteum was intermediate between femoral shaft periosteum and femoral neck cancellous bone. In conclusion, bone formation and resorption are active in the femoral neck periosteum and have the potential to exert meaningful effects on femoral neck size. The modeling rate at the femoral neck is different from femoral shaft periosteal and cancellous bone sites, suggesting distinct regulatory influences.

Disclosures: ***M. Bliziotes****, None.*

SU313

57. **Regional Trabecular Anisotropies Suggest a 'Two-Domain' Loading Regime in the Proximal Femur.** J. G. Skedros. Ortho, U of Utah, Salt Lake City, UT, USA.

Conventional wisdom teaches that the human proximal femur is adapted for transmission of tension/compression stresses associated with habitual bending. This appears to be embodied as arched trabecular patterns. However, recent 3-D finite-element analyses (FEAs) of physiologic loading suggest an alternative interpretation for stress transfer across this region [Lotz et al., 1995, Osteopor. Int.]. These analyses suggest that the 'expanded' trochanteric region allows for the appropriate mechanical advantage and attachment site for muscles rather than for structural integrity of the bone itself. Studies of patterns of predominant collagen fiber orientation (CFO) in cortical bone suggest that prevalent bending occurs in the subtrochanteric region, and prevalent torsion/compression at mid-neck. These data suggest that the trochanteric region may separate two loading 'domains' (subtrochanteric and femoral neck (FN)), each with important differences in stress distribution and transfer. This issue is relevant in understanding normal loading conditions across the hip and bone mass/quality changes that occur with age and implantation of intramedullary prostheses, and may have implications for age-related changes in the prevalence of FN vs. intertrochanteric fractures. Rigorously examining this 'two-domain' hypothesis is difficult because it requires the application of in vivo strain gauges. In this study we examined this question using patterns of trabecular architecture. 5mm thick sections of 15 Caucasian human femora (age range 20-70) were obtained in the plane of anteversion. Using radiographs of each specimen, obvious arched trabecular tracts were traced in the FN and lesser trochanteric (LT) regions. Cartesian data of each tract (superior & inferior in FN; lateral & medial in LT) were fit to linear or non-linear equations ($r^2 > 0.95$). Intersection angles at 'arch' apices were measured. Results (Table) demonstrate that the LT trabecular tracts are symmetric, and FN tracts are non-symmetric. The LT region exhibits intersections that are nearly orthogonal, in contrast to the non-orthogonal intersections in the FN ($p<0.05$). These data are consistent with the 'two-domain' hypothesis, as suggested previously by CFO data and FEAs showing that non-orthogonal, non-symmetric trabecular tracts are optimal for habitual torsion [Pidaparti and Turner, 1997; J Biomech].

Equations	Sup. FN	Inf. FN	Lat. LT	Med. LT
y^(-1)=a+b/x	93.8%	37.5%	100%	100%
y=a+bexp(-x/c)	6.2%	56.3%	0%	0%
y=ax+b	0%	6.2%	0%	0%
Angle of Intersect	69+/-12 deg		92+/-6 deg	

Disclosures: ***J.G. Skedros****, None.*

SU314

Structural and Biomechanical Basis for Differences in Vertebral Fragility in Chinese and Caucasians. Y. Duan[1], X. Wang*[1], C. H. Turner[2], C. Fong*[1], E. Seeman[1]. [1]Endocrinology, Austin & Repatriation Medical Centre, The University of Melbourne, Melbourne, Australia, [2]The Biomechanics and Biomaterials Research Centre, Indiana University, School of Medicine, IN, USA.

We hypothesized that the structural abnormalities predisposed to vertebral fracture are similar in Chinese and Caucasians, accounting for the similar vertebral fracture rates between races. We studied 687 healthy Chinese (449 females) and 1088 healthy Caucasians (738 females) aged 18 to 92 yrs. Vertebral body (VB) cross-sectional area (CSA) and volumetric BMD (vBMD, excluded posterior elements) were measured using dual x-ray absorptiometry by postero-anterior and lateral scanning. We calculated VB stress (load/CSA) and FRI (load/strength) during bending forward. In young adulthood, VB stress did not differ by race in either sex because the lower load (10-14%) in Chinese was distributed on a proportionately lower CSA (13-14%) than in Caucasians. However, vBMD was 9-13% higher in Chinese than Caucasians, conferring 12-19% lower FRI in Chinese men and women. Ageing was associated with increased CSA in both Chinese and Caucasian men and women. However, racial differences in periosteal expansion were minimal, increasing by 8.7% and 11.8% in elderly Chinese and Caucasian men, and increasing by 8.6% and 5.7% in elderly Chinese and Caucasian women (both no significant different to each other). VB stress decreased similarly in Chinese and Caucasian men (13.3% vs 13.7%) but decreased more in Chinese than Caucasian women (10.0% vs 5.5%, $p < 0.01$). Net decline in vBMD was greater in elderly Chinese than Caucasian women (33% vs 27%, $p < 0.01$) but similar in Chinese and Caucasian men (11% vs 12%). These structural changes were captured by FRI; a similar proportion of elderly Chinese and Caucasians men (5% vs 6%) and women (25% vs 29%) had the FRI >= 1. The results are consistent with the notion that vertebral fractures occur more commonly in women than in men but similar proportions of Chinese and Caucasians (of either sex) sustain fractures.

Disclosures: ***Y. Duan****, None.*

SU315

Structural Basis for Differences in Femoral Neck Fragility in Chinese and Caucasians. X. Wang*[1], Y. Duan[1], T. J. Beck[2], E. Seeman[1]. [1]Endocrinology, Austin & Repatriation Medical Centre, The University of Melbourne, Melbourne, Australia, [2]Radiology, The Johns Hopkins University, School of Medicine, Baltimore, MD, USA.

We hypothesized that structural characteristics may be better maintained in Chinese than Caucasians in old age, accounting for the lower hip fracture rates reported in epidemiological studies. A faster rate of periosteal apposition maintains bending strength, while a slower rate of periosteal expansion with a slower rate of endocortical resorption should reduce the increased risk of buckling with age. We measured femoral neck (FN) dimensions and bone mass using DXA, estimated endocortical diameter, cortical thickness, section modulus (a measure of bending strength), and buckling ratio (subperiosteal radius/cortical thickness) in 738 Chinese (490 females) and 1181 Caucasians (788 females) aged 18 to 93 years. In young adult women, after adjusting for racial differences in height and weight, FN axis length and diameter remained 4-8% lower in Chinese, while cortical thickness and vBMD were no different by race. Thus, growth produced racial differences in FN geometry; the same cortical thickness was distributed further from the FN neutral axis conferring 22.3% greater bending strength in Caucasians than Chinese. However, buckling ratio was 5.2% lower in Chinese than Caucasian women. In young adult men, bending strength was 12.5% lower while buckling ratio was no different in Chinese compared to Caucasians. From young (~30yrs) to old age (~70yrs), FN periosteal diameter (height and weight adjusted) increased less in Chinese than Caucasian men (1.0% vs. 9.1%), but increased similarly in Chinese and Caucasian women (4.6% vs. 3.3%). Endocortical diameter also increased less in Chinese than Caucasian men (2.6% vs. 12.5%), but similarly in Chinese and Caucasian women (8.5% vs. 6.5%). Consequently, bending strength decreased by 6.9% in Chinese men but maintained in Caucasian men, while bending strength decreased similarly in Chinese and Caucasian women (4.0% vs 6.9%). Buckling ratio increased less in Chinese than Caucasian men (14.5% vs 28.4%) but increased similarly among Chinese and Caucasian women (28.8% vs 31.2%). These changes produced 17.4-25.0% lower bending strength and 6.9-8.7% lower buckling ratio in elderly Chinese than Caucasians in both sexes. We concluded that despite the smaller FN diameter and lower bending strength, the relatively thicker cortex and narrower diameters in elderly Chinese suggest a lower risk of structural failure by local buckling than Caucasians. These structural differences in Chinese and Caucasians are likely to be established during both growth and aging.

Disclosures: ***Y. Duan****, None.*