



POSTER #14

FUNCTIONAL ADAPTATION OF THE NORMAL CALCANEUS COMPARED TO THE HISTORICAL EXAMPLE OF FOOT BINDING

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The normal structure of human feet is optimized for shock dampening during walking and running. Foot binding was a historical practice in China aimed at restricting the growth of female feet for aesthetic reasons. In a bound foot the shock-dampening function normally facilitated by the foot arches is withdrawn, resulting in the foot functioning as a rigid extension of the lower leg. An interesting question inspiring this study is the nature of adaptation of the heel bone (calcaneus) to this non-physiologic function using the parameters of trabecular bone anisotropy and 3D fabric topology while using the normal foot calcaneus as control. Surprisingly, the results revealed that while the trabecular fabric of the normal calcaneus indeed adapts to function by increased anisotropy following the physiologic stress trajectories, in the bound foot calcaneus the characteristic anisotropy pattern fails to develop reflecting the lack of the normal biomechanical input. Moreover, the basic topological blueprint of trabecular bone is nearly invariant in both normal and bound foot calcanei. These findings suggest that the anisotropic trabecular bone texture of the normal calcaneus is an acquired characteristic that reflects recurrent loading conditions; an inadequate biomechanical input precludes the formation of anisotropic texture; the conserved topological parameters characterize the generic 3D fabric of trabecular bone, which is to a large extent independent of its adaptation to recurrent loading.

References:

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3. Reznikov N, *et al.* Inter-trabecular angle: A parameter of trabecular bone architecture in the human proximal femur that reveals underlying topological motifs. *Acta Biomaterialia* 44:65-72 (2016).

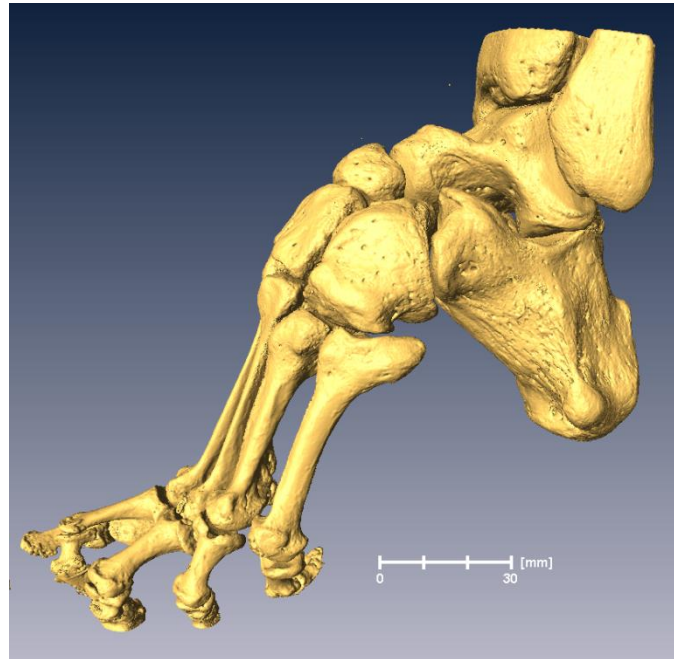


Figure 1. 3D rendering of a bound foot (museum specimen), μ CT.

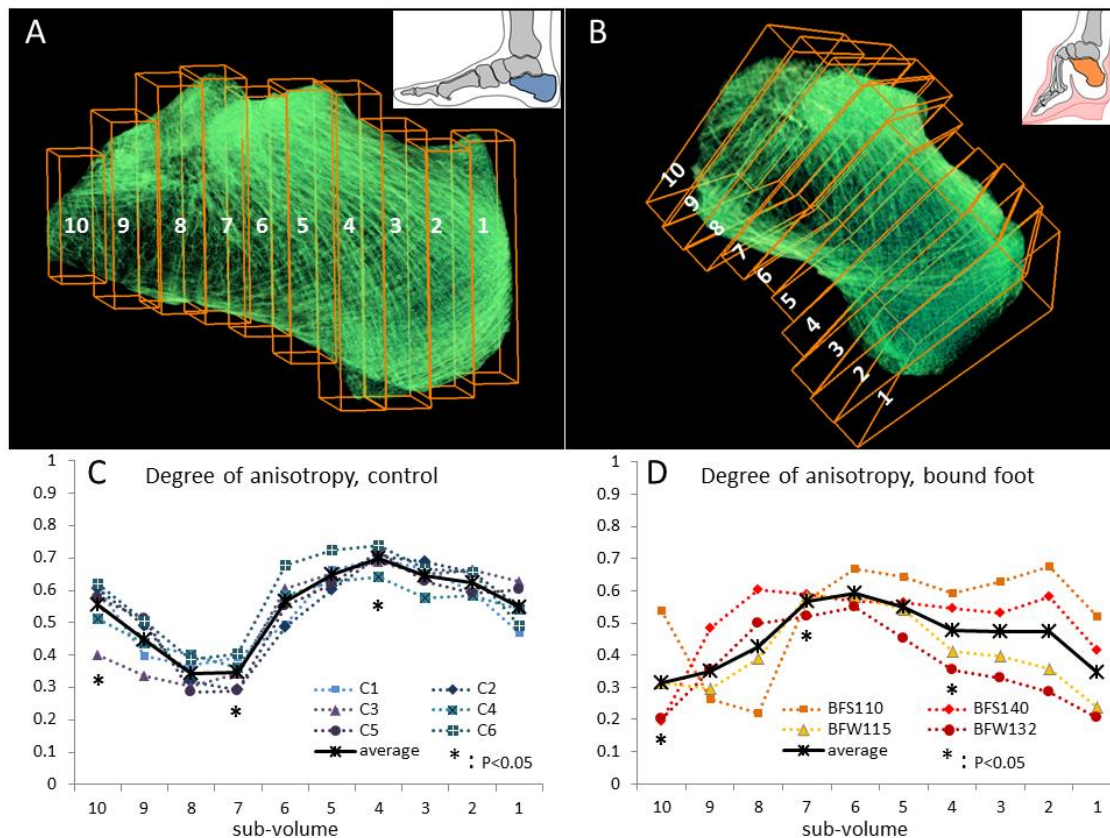


Figure 2. Comparison of anisotropy patterns in the calcaneus of normal and bound feet.