

RADIUS FRACTURE RISK PREDICTION USING NUMERICAL SIMULATION INCLUDING REALISTIC BOUNDARY CONDITIONS

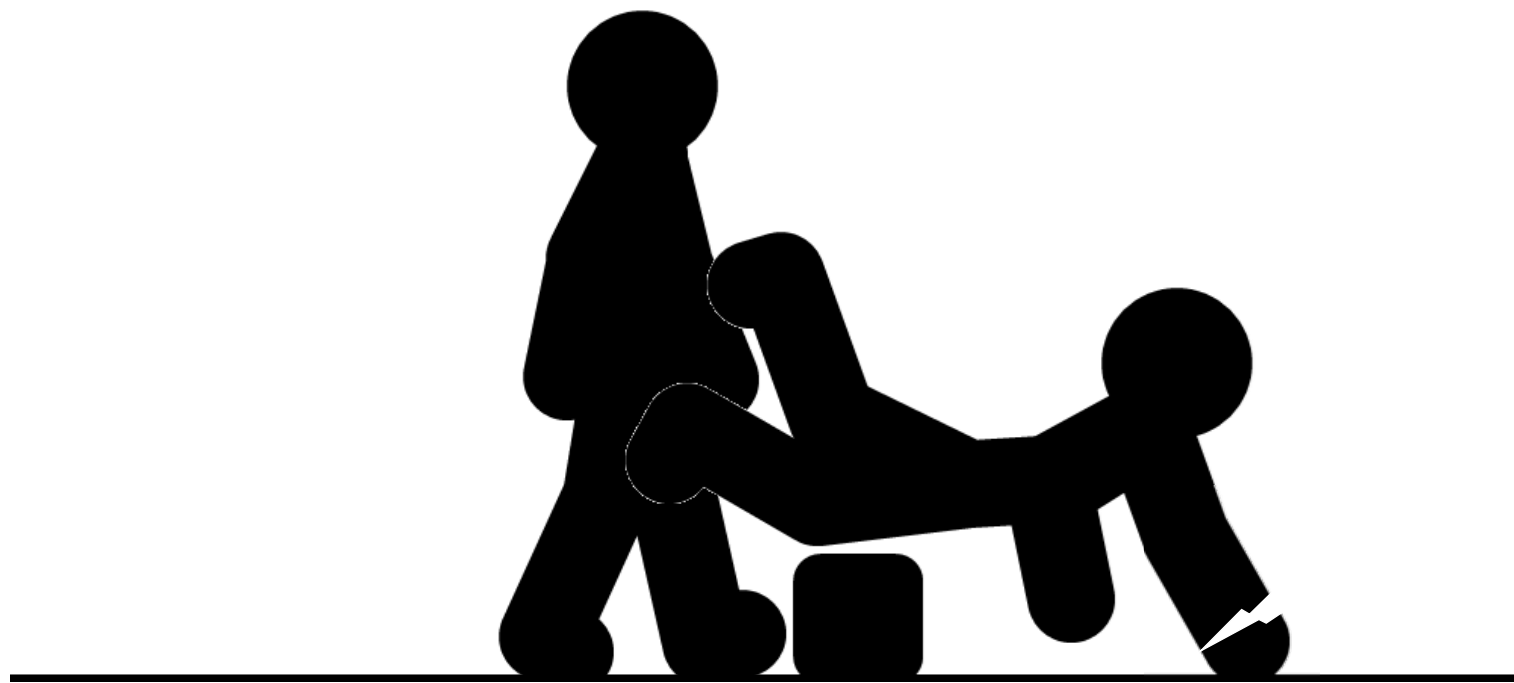
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Context – Radius fracture



Non-Fractured



Fractured

Prediction of Bone strength and Fracture risk

Dual X-ray Absorptiometry (DXA) : Estimation of the Bone Mineral Density (BMD)



Terminology	T-score definition
Normal	$T \geq -1.0$
Osteopenia	$-2.5 < T < -1.0$
Osteoporosis	$T \leq -2.5$



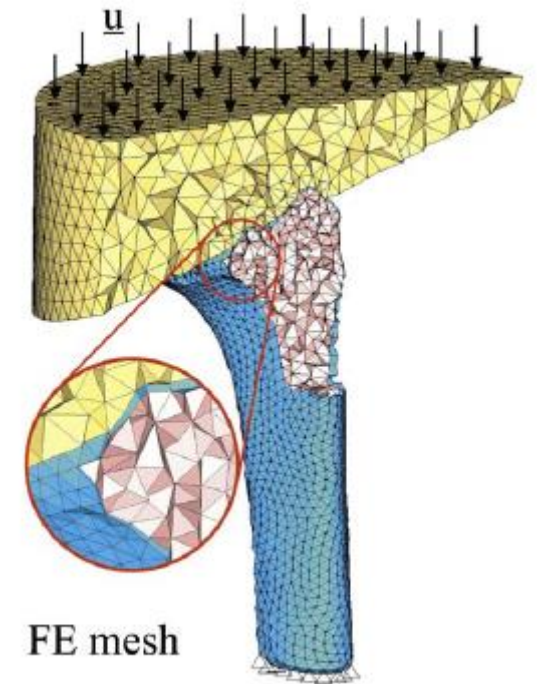
Left radius DXA scan

50% of fractures occur in patients considered non-osteoporotic (Siris et al. Arch Intern Med. 2004)

Prediction of Bone strength and Fracture risk

Patient-Specific Finite Elements Models (FEM) : Radius

Authors	Limitations
Varga et al. J of Biomech. 2009	Simplification of the in vivo mechanism
Edwards et al. Med Eng Phys 2011	Strain rate in the experiment was much less than that during the real fall
Hosseini et al. Bone 2017	Boundary conditions (uniaxial compression) does not reflect the loading necessary to produce radii's fracture <i>in vivo</i>
Zhou et al. J of Biomech. Eng. 2019	Experiment does not fully represent the real loading condition the radius experiences during a fall



FE mesh

Varga et al.
J of Biomech. 2009

The case of a fall

Only 15% of the falls involves an axial loading of the radius. (Melton et al. Osteoporosis Int. 2010).

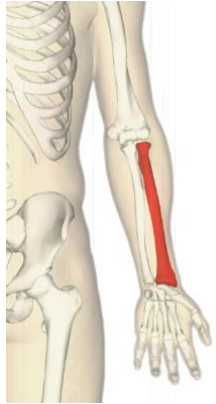
Falls from stand height can reach 2m/s (Tan et al. J.Biomech 2006)

With an angle of 75 degrees (Greenwald et al. The American journal of sport Medicine 1998)

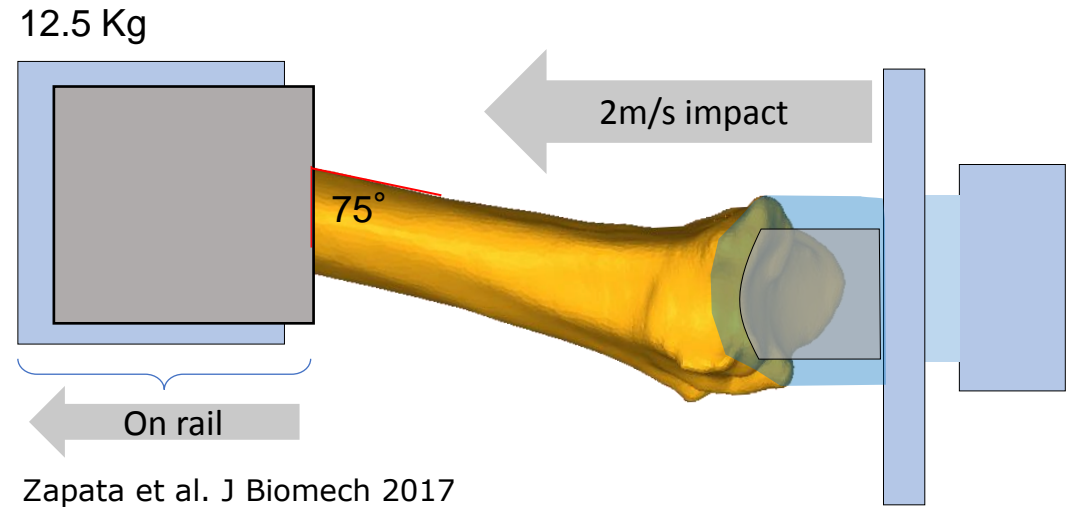
Which can be considered as a dynamic non axial loading.



Methods

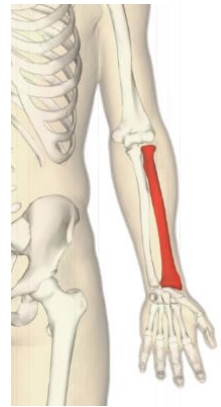


30 Left Radius Ex vivo

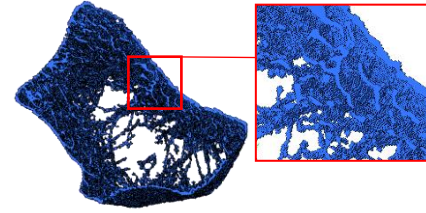


Zapata et al. J Biomech 2017

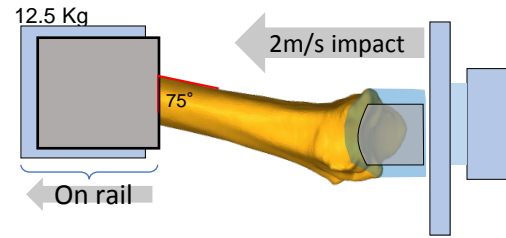
Methods



30 Left Radius Ex vivo



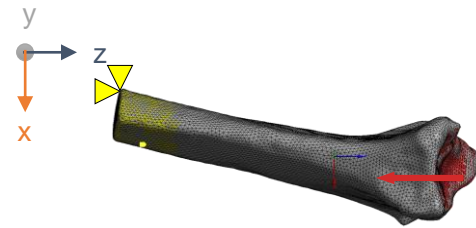
Voxel based equivalent



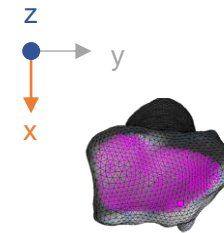
Non-fractured



Fractured



Full body continuum model





LOVELY



CREATIVELY



LIVELY



INGENIOUSLY



CLEVERLY



TASTEFULLY

