Osteoporosis is a killer

Osteoporosis is a life threatening disease. OP fractures kill as many women as breast cancer. 30 to 50% of all women and 15 to 30% of all men will face an osteoporotic fracture in their lifetime. 4,000,000 fractures cost the European health system more than 30 billion Euro per year. This figure is likely to double by 2050. 250,000 elders will die of related complications within 12 month; all others will remain impaired. The technology in current clinical practice is clearly insufficient. The accuracy in predicting fractures is as low as 60%. Even if we see the drugs are not working we wait for the fracture, and only then surgically fix it. We need better ways to prevent osteoporotic fractures.

Predictive, Personalised and Integrative medicine (PPI)

Bone physiology is as complex as any other organ, but the biomechanics of bone fracture is in itself a purely mechanical event. This is one of the few domains where organ-level models already achieve predictive accuracies of over 90%. The VPHOP project will make possible Predictive and Personalised (P2) medicine for osteoporosis:
- Predictive: multiscale models representing the skeletal mechanobiology from the whole body down to the molecular constituents, simulate the skeletal loading in various conditions and predict if the bones will fracture in each of them.
- Personalised: the multiscale model is personalised using specific patient information. The more available information, the more personalised the model becomes.

The Integrative model

OP fracture is multiscale:
- Body musculoskeletal anatomy and neuromotor control define the daily loading spectrum, which includes parophysiological overloading events
- Fracture events occur at Organ level
- Tissue morphology defines the bone elasticity
- The Cell activity changes the tissue morphology and composition over time
- The Constituent of the extracellular matrix are the prime determinants of the tissue strength

Current standard of care:

Current fracture predictions are based on historical, fracture-patient data sets to identify key factors which contribute to the increased probability of an osteoporotic fracture. This approach oversimplifies the mechanisms leading to an osteoporotic fracture and fail to take into account numerous, hierarchical factors which are unique to the individual.

Prognosis
- Predicting the absolute risk of femoral or vertebral fracture under low energy loading.
- Predicting the probability of developing microfractures at the tissue level.

VPHOP clinical protocol

Pharmacological treatment planning
- Predicting changes over time due to the evolution of osteoporosis.
- Predicting the changes in risk due to the pharmacological treatment.

Interventional treatment planning
- Predicting the most clinical location within each bone.
- Predicting the changes in risk due to interventional augmentation.