Research Field And Department	Biomechanics – Mechanical Engineering Department
Supervisor	Miguel Marco
Title of the Work	Biomechanical assessment of osteoporotic femurs reinforced with advanced bioabsorbable polymers

Abstract:
This research project focuses on the development of numerical models and experimental tests to quantify the mechanical stability of the human femur after the injection of advanced bioabsorbable polymers. This novel technique aims to prevent hip fractures in elderly patients by reinforcing osteoporotic bone structures. Through computational simulations and laboratory experiments using bone simulants, the project seeks to evaluate the effects of polymer injection on femoral stiffness, strength, and load-bearing capacity. The approach combines finite element analysis with biomechanical testing to validate model predictions, by means of Digital Image Correlation to compare the results. The injected polymers are designed to be fully absorbable, promoting long-term biocompatibility and natural bone regeneration. Ultimately, this study contributes to the design of minimally invasive treatments that enhance bone stability and reduce fracture risk in aging populations.

Main Tasks to Carry Out:
-Finite element modelling of femur structure, including polymeric material as a stiffener.
-Experimental testing combining a synthetic femur, different loading conditions, and Digital Image Correlation for comparison of the results with finite element models.
-Surgical treatment in a synthetic femur for injecting bioabsorbable polymers with the help of an experienced traumatologist.

References/Bibliography if required
-Marco, M., Giner, E., Caeiro-Rey, J.R., Miguélez, M.H., Larraínzar-Garijo, R. Numerical modelling of hip fracture patterns in human femur. Computer Methods and Programs in Biomedicine, 2019, 173, pp. 67–75.
-Paech, A., Wilde, E., Schulz, A.P., Heinrichs, G., Wendlandt, R., Queitsch, C., Kienast, B., Jürgens, C.H. Biopolymer augmentation of the lag screw in the treatment of femoral neck fractures - a biomechanical in-vitro study. European Journal of Medical Research, 2010, Apr 8;15(4):174–179.