Università degli Studi di Pavia
Computational Mechanics & Advanced Materials Group - DICAr

3D@UniPV
Virtual Modeling and Additive Manufacturing for Advanced Materials

SEMINAR

Patient specific CT-based FEA of femurs – a leap to daily clinical practice

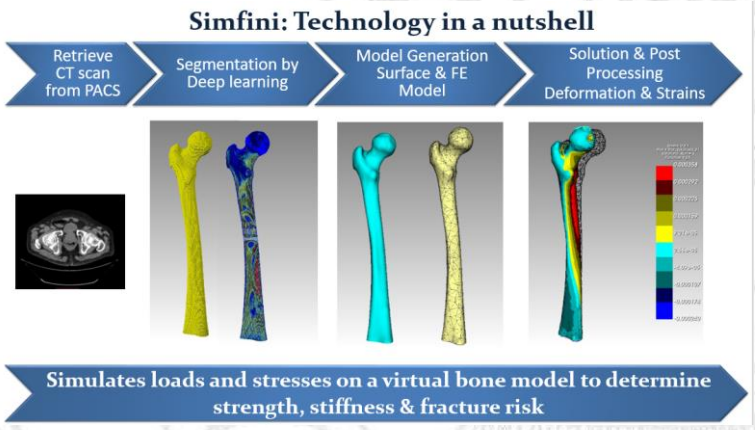
Patient-specific CT-based high-order finite element models (p-FEMs) accurately predict ex-vivo experimental observations on human femurs and humeri, including risk of fracture [1-3]. They account for the exact geometry and inhomogeneous material properties, are created in a semi-automated manner from CT scans and validated on a large cohort of fresh frozen bones. CT-based p-FEMs were applied to predict bone strength in patients with bone tumors to their femur [4], demonstrating excellent prediction capabilities. The first part of the talk addresses the methodology to automatically generate the bone's FEM from CT scans, assign material properties, apply physiological load and interpret the FE results according to surgeon's need.

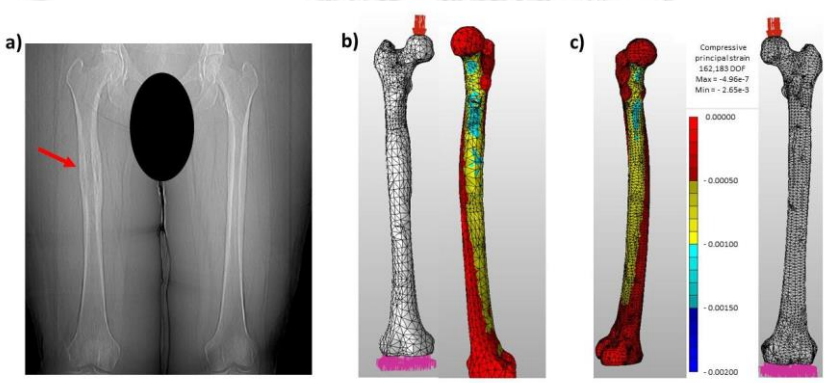
Application of FE methodology in clinical practice is subject to obstacles and surprises, however, at the same time is accompanied by tremendous satisfaction when it helps patients and saves pain and agony. The second part of the talk will address our clinical experience in bringing the methodology into clinical practice related to the need of a prophylactic surgery of femurs with metastatic tumors [5].

Several cases analyzed during the clinical trials will be presented.

References:

[1] N. Trabelsi et al., *J. Biomech.*, 44:1666-1672, 2011.
[2] Z. Yosibash, et al., *Phyl. Tran. of the Roy Soc.: A*, 368:2707-2723, 2010.
[3] G. Dahan, et al., *J. Biomech.*, 49:1049-1102, 2016.
[4] Z. Yosibash, et al., *Bone*, 69:180-190, 2014.
[5] A. Sternheim et al., *Bone*, 110:215-220, 2018





Radiograph FEA of a 43 y.o., 120kg female with a metastatic breast cancer tumor in the right femur who underwent prophylactic surgery but FEA results showed no fracture risk. The metastatic lesion is permeative, with significant cortical changes juxtaposing the lesion. a) Radiograph. b) & c) FE model and maximum compressive principal strains at 2.5 body weights stance position. Colors represent the maximum compressive principal strains.

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DICAr MS1 Meeting Room
Via Ferrata, 3 – Pavia