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Fibre collagene in condizioni fisiologiche, patologiche e di ingegneria tessutale: focus su come la gravità contribuisca alla loro organizzazione 3D, all'attivazione dei segnali e alla funzione dei tessuti

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***Sessione 1: Effetti delle condizioni ambientali spaziali sulla fisiopatologia umana
Individuazione, sviluppo ed applicazione di contromisure (FIS)***



**Simposio di “Biomedicina Spaziale per le Future Missioni di Esplorazione Umana dello Spazio:
a Call to Action”**

Agenzia Spaziale Italiana, Via del Politecnico, snc, 00133, Roma - 15-17 Marzo 2023

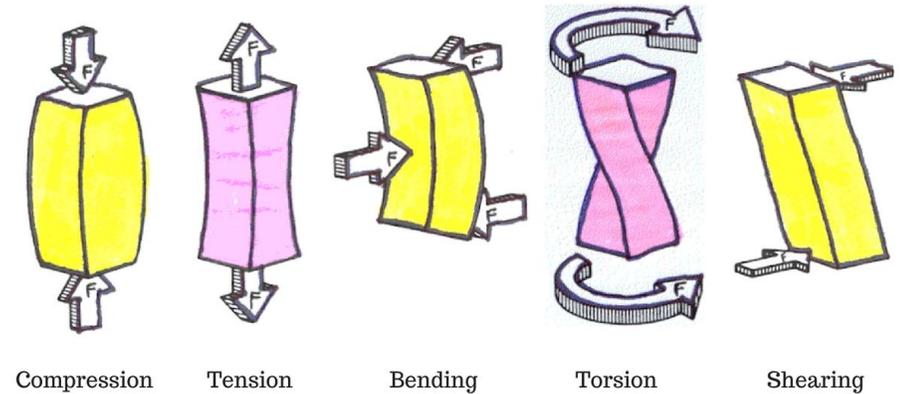


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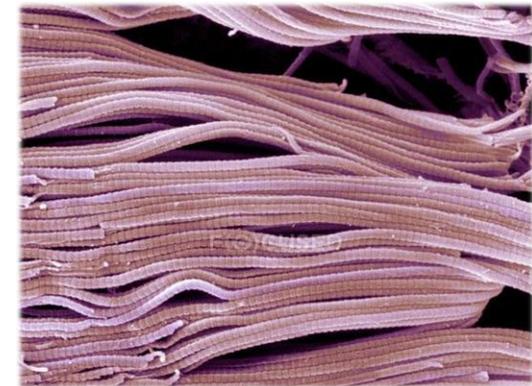
I tessuti viventi

GENERANO,
PERCEPISCONO
RESISTONO
RISPONDONO

allo stress meccanico



i segnali meccanici operano in tandem con segnali biochimici



Gli stimoli meccanici (o la loro assenza), incluse le forze gravitazionali, condizionano anche la composizione, quantità e distribuzione della ECM, con ricadute nei processi fisiopatologici ma anche nei processi di riparazione delle ferite

Collagen Fibrils Mechanically Contribute to Tissue Contraction in an In Vitro Wound Healing Scenario

Erik Brauer, Evi Lippens, Oliver Klein, Grit Nebrich, Sophie Schreivogel, Gabriela Korus, Georg N. Duda, and Ansgar Petersen*

Adv. Sci. 2019, 6, 1801780

Wound contraction is an ancient survival mechanism of vertebrates that results from tensile forces supporting wound closure. So far, tissue tension was attributed to cellular forces produced by tissue-resident (myo-) fibroblasts alone. However, difficulties in explaining pathological deviations from a successful healing path motivate the exploration of additional modulatory factors. Here, it is shown in a biomaterial-based in vitro wound healing model that the storage of tensile forces in the extracellular matrix has a significant, so-far neglected contribution to macroscopic tissue tension. In situ monitoring of tissue forces together with second harmonic imaging reveal that the appearance of collagen fibrils correlates with tissue contraction, indicating a mechanical contribution of tensioned collagen fibrils in the contraction process. As the re-establishment of tissue tension is key to successful wound healing, the findings are expected to advance the understanding of tissue healing but also underlying principles of misregulation and impaired functionality in scars and tissue contractures.

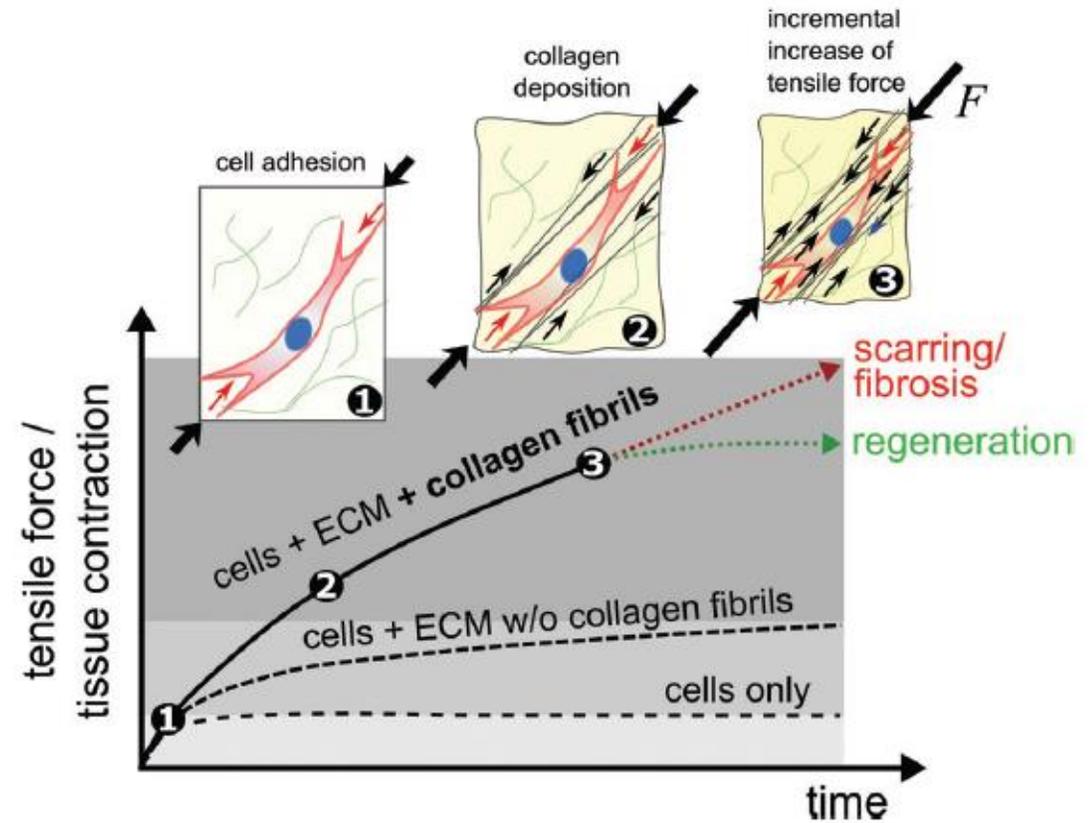
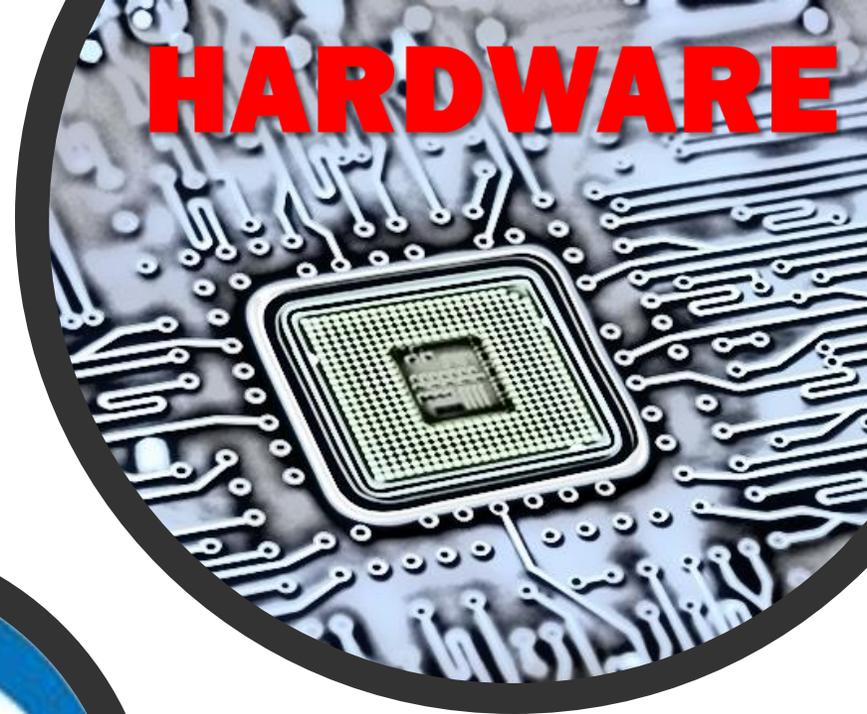
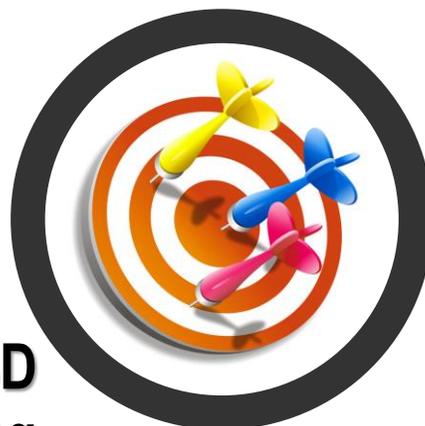


Figure 6. Fibrillar collagen amplifies single cell forces. Graphical illustration of the here described tissue formation and tensing process. Following initial cellular spreading and adhesion (1), cells incrementally deposit tensioned collagen fibrils (black arrows, 2) which leads to a gradual increase in the total force resulting in a macroscopic contraction (3). By this, the amount of macroscopic force exceeds the sum of single cell forces or contributions from nonfibrillar ECM networks. The collagen deposition rate thus determines the quantity of macroscopic contraction and tensing of regenerating tissues, which is important to restore their function. Increased contraction, however, is associated with pathologies such as fibrosis and cancer.



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1. **IDENTIFICARE** parametri morfometrici 3D del tessuto **collagene** derivanti dall'**Imaging di Luce di Sincrotrone**
2. **RICOSTRUIRE** le **forze** che agiscono localmente in **tessuti patologici (fibrotici o cancerosi) o rigenerati**, anche attraverso condizionamenti di gravità modificata



**SOFTWARE &
ARTIFICIAL INTELLIGENCE**

IMAGING



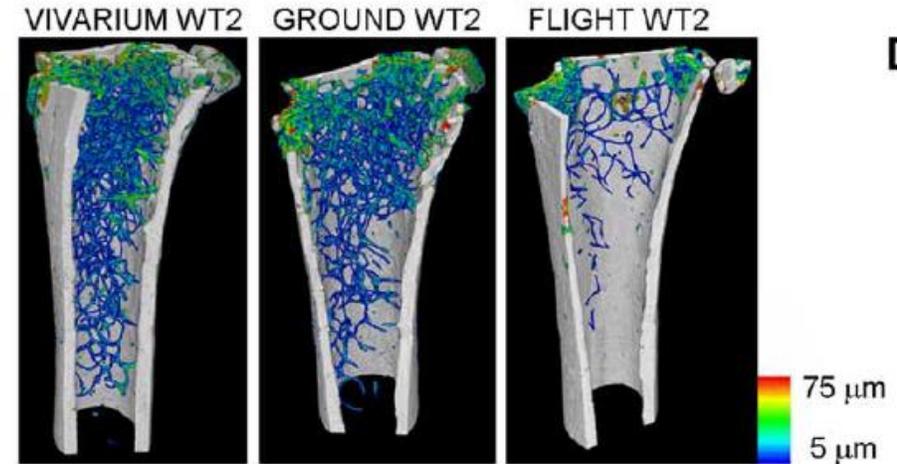
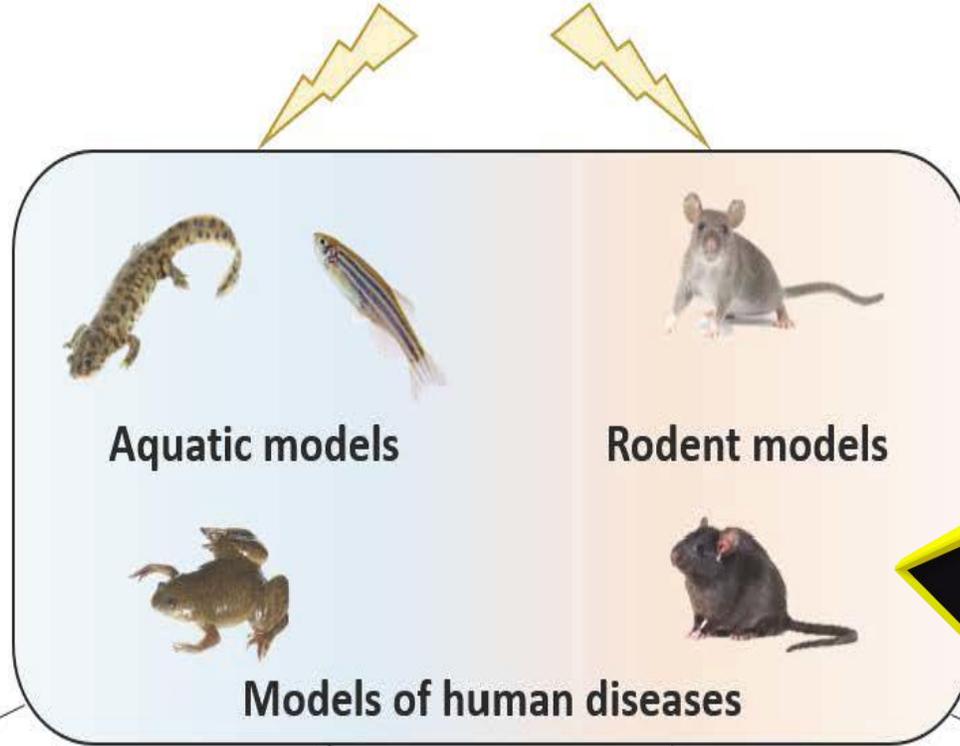
Mechanical stresses

(hypergravity or microgravity)

OPEN ACCESS Freely available online

Bone Turnover in Wild Type and Pleiotrophin-Transgenic Mice Housed for Three Months in the International Space Station (ISS)

Sara Tavella^{1,2,3*}, Alessandra Ruggiu^{1,2,3}, Alessandra Giuliani^{3,9}, Francesco Brun^{4,5}, Barbara Canciani^{1,2}, Adrian Manescu^{3,6}, Katia Marozzi^{3,6}, Michele Cilli², Delfina Costa^{1,2}, Yi Liu^{1,2}, Federica Piccardi², Roberta Tasso^{1,2}, Giuliana Tromba⁵, Franco Rustichelli³, Ranieri Cancedda^{1,2}



JOURNAL OF THE MECHANICAL BEHAVIOR OF BIOMEDICAL MATERIALS 51 (2015) 1-12



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Research Paper

Effects of long time exposure to simulated micro- and hypergravity on skeletal architecture

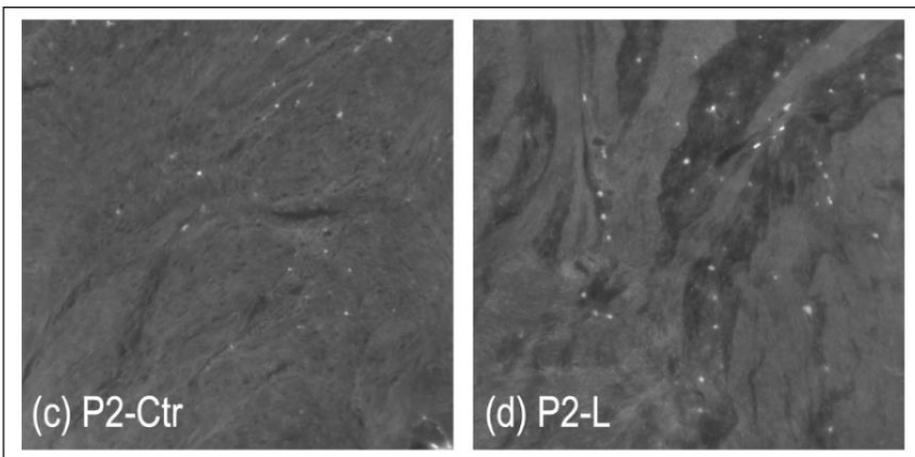
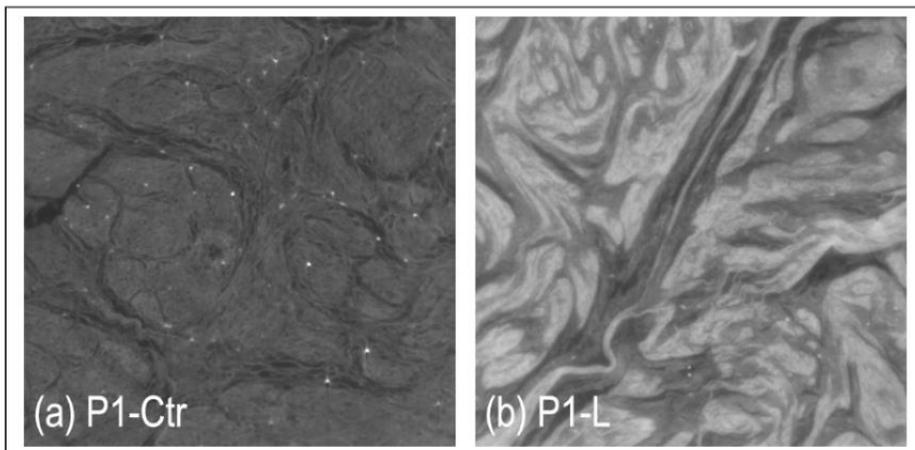
Barbara Canciani^{a,1}, Alessandra Ruggiu^{a,1}, Alessandra Giuliani^{b,1}, Daniele Panetta^c, Katia Marozzi^b, Maria Tripodi^c, Piero A Salvadori^c, ...





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GINECOLOGIA – FIBROMI UTERINI



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SCIENTIFIC REPORTS

OPEN

Advanced 3D Imaging of Uterine Leiomyoma's Morphology by Propagation-based Phase-Contrast Microtomography

Received: 13 March 2019
Accepted: 10 July 2019
Published online: 22 July 2019

Alessandra Giuliani¹, Stefania Greco², Serena Pacilè³, Alessandro Zannotti^{1,2}, Giovanni Delli Carpini¹, Giuliana Tromba³, Stefano Raffaele Giannubilo¹, Andrea Ciavattini¹ & Pasquapina Ciarmela²

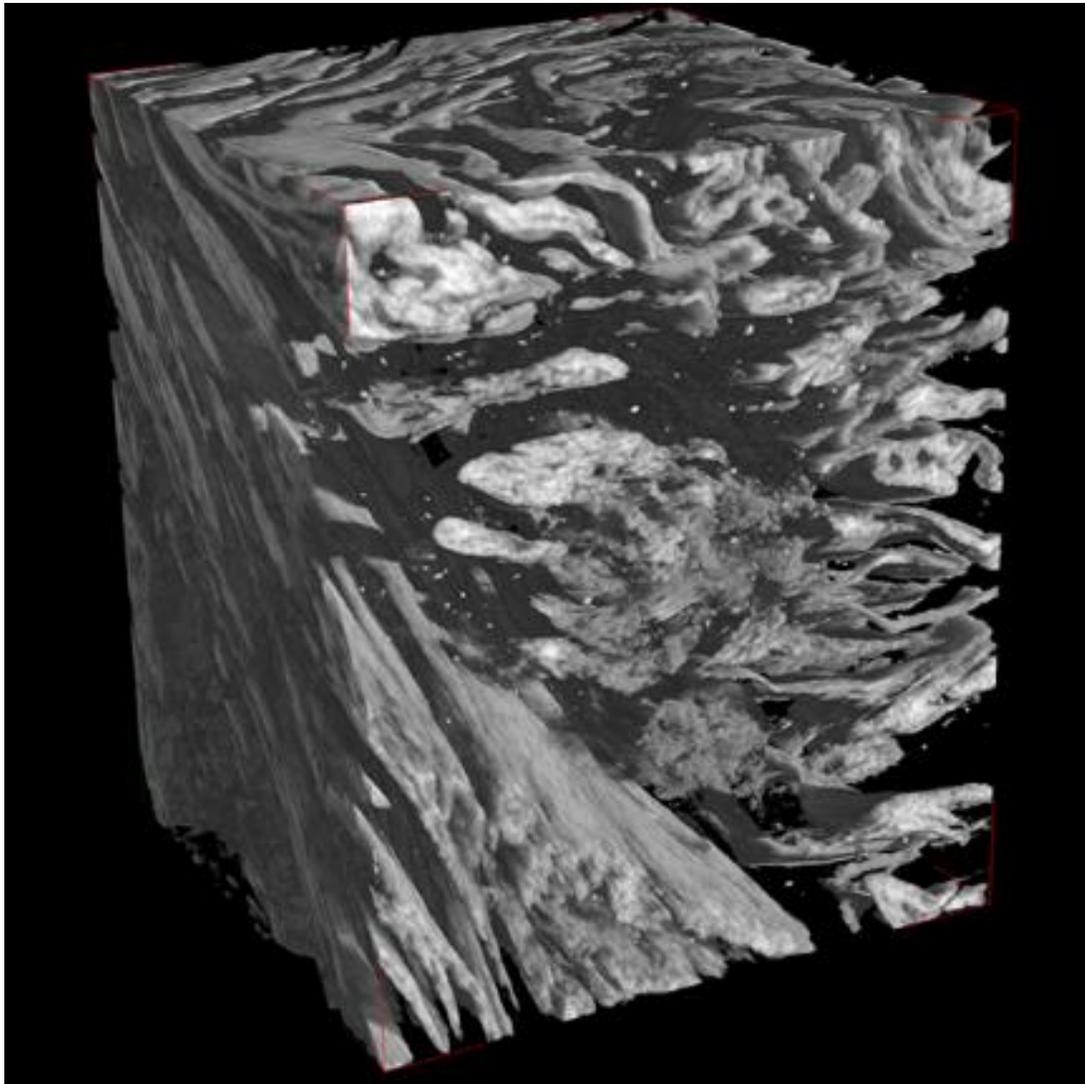


Article

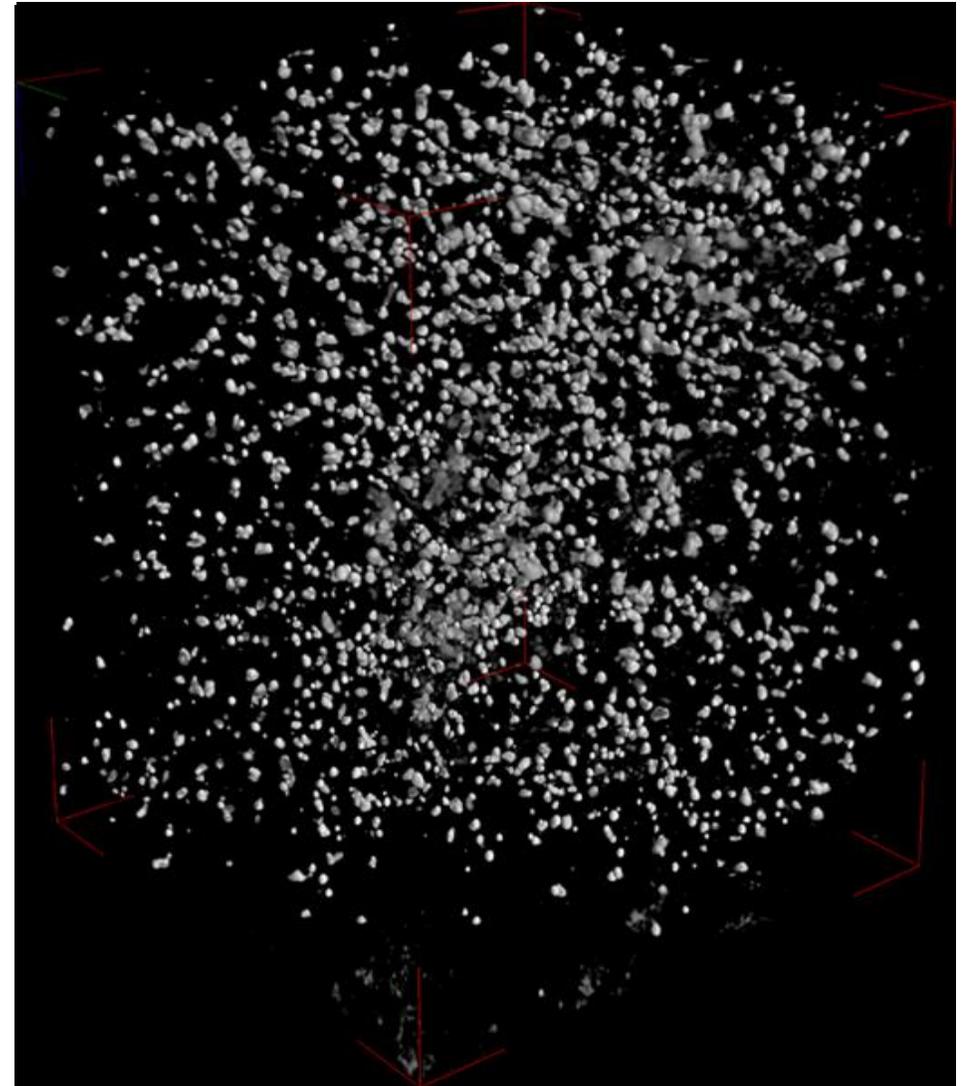
Shedding new light on omega-3 fatty acids effects on uterine leiomyoma tissues: an ex-vivo Ultrastructural Advanced Imaging approach

Alessia Belloni^{1§}, Michele Furlani^{2§}, Stefania Greco^{3§}, Valentina Notarstefano¹, Chiara Pro¹, **Basilio Randazzo¹, Pamela Pellegrino³, Alessandro Zannotti⁴, Giovanni Delli Carpini⁴, Andrea Ciavattini⁴, Francesca Di Lillo⁵, Elisabetta Giorgini^{1*}, Alessandra Giuliani^{2*}, Saverio Cinti³ and Pasquapina Ciarmela³**

Leiomioma



Miometrio Sano



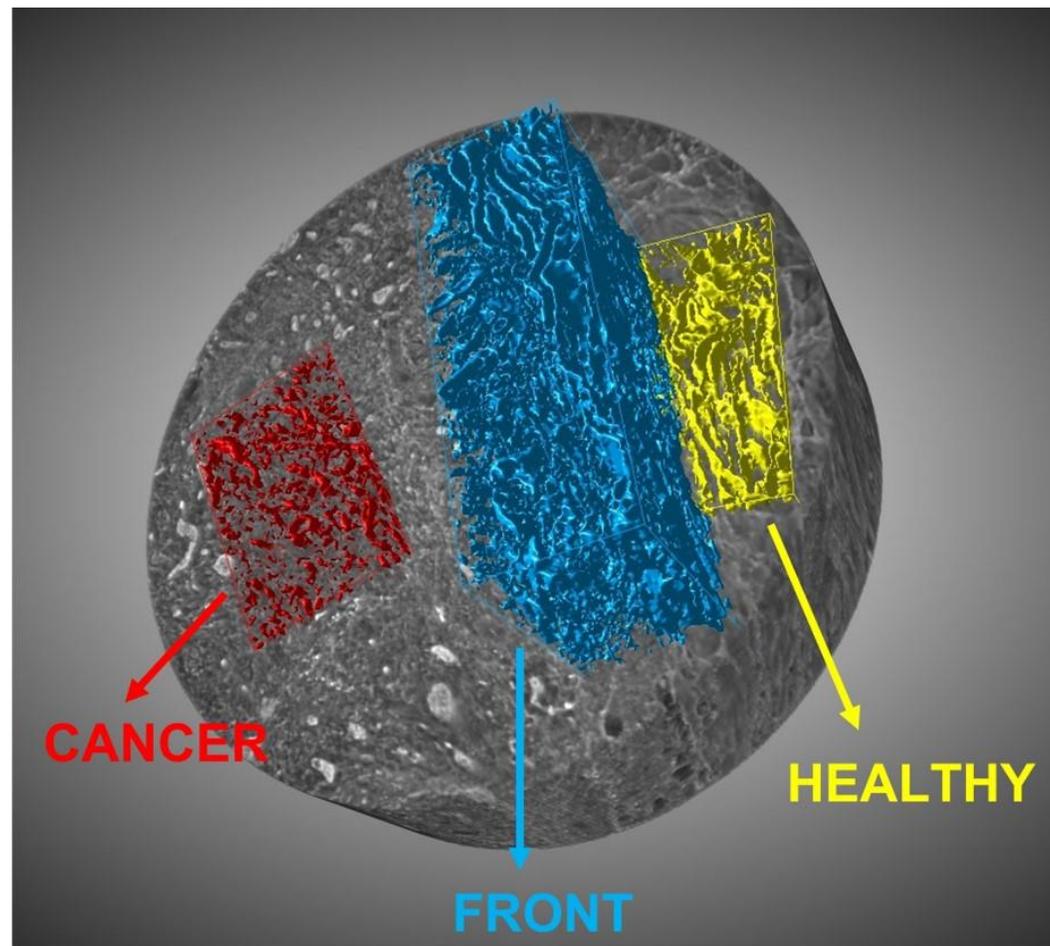
PATOLOGIA ORALE – TUMORE DELLA LINGUA A CELLULE QUAMOSE



Elettra Sincrotrone Trieste



EURO
BIOIMAGING

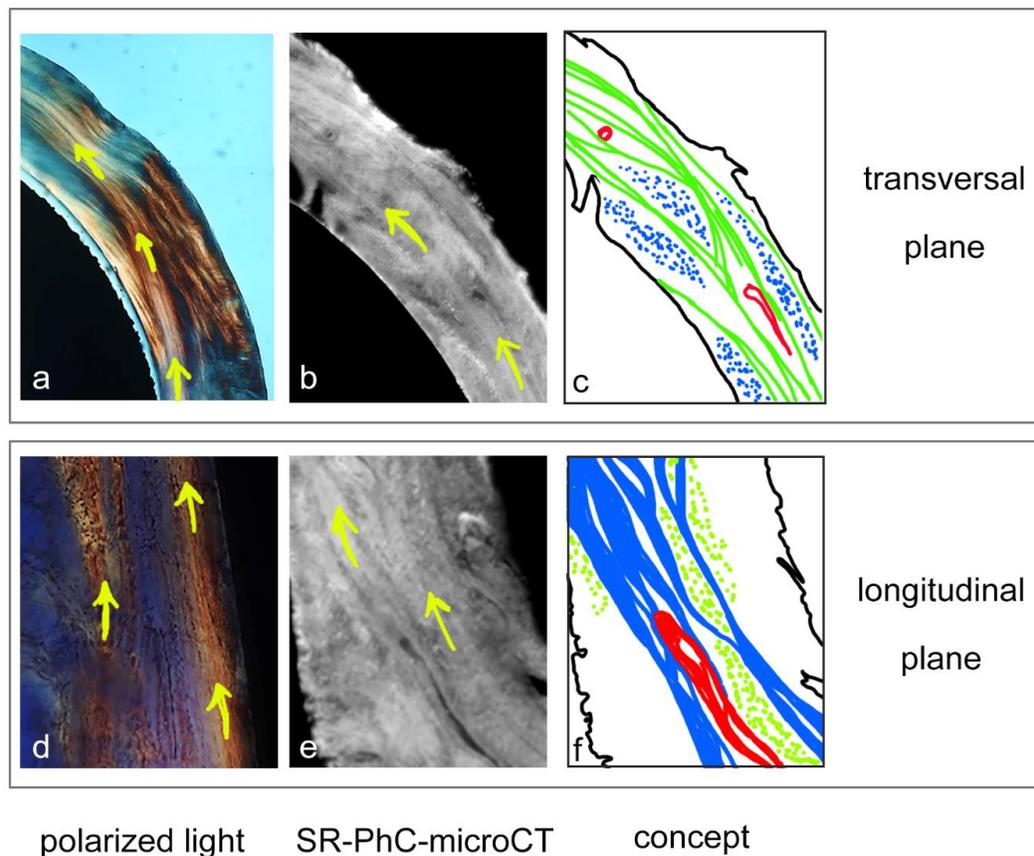
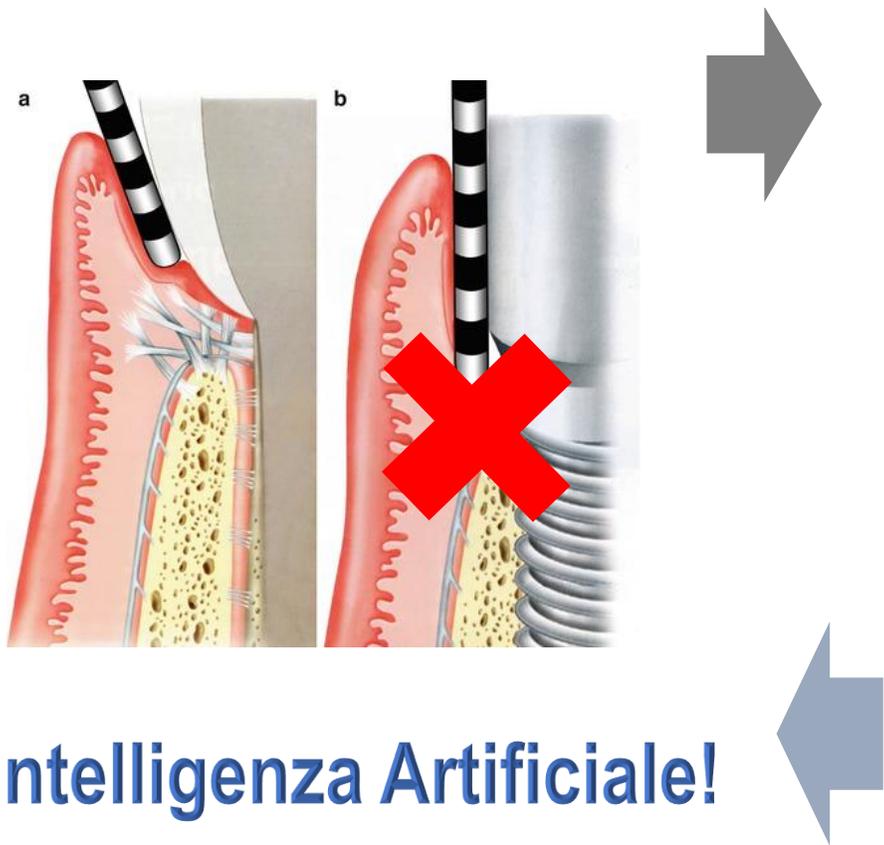
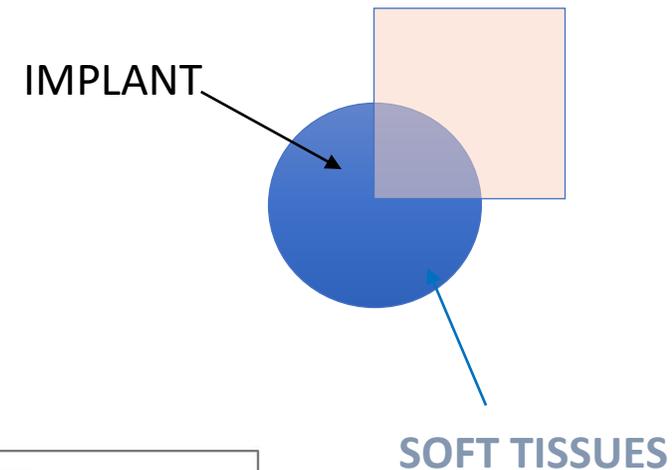


Manuscript IJOS202303153: "Collagen characterization in tumor stroma of oral tongue squamous cell carcinoma: a morphometric and macro-molecular analysis by two high-resolution radiation-based imaging techniques«, by Alessandra Giuliani, Lucrezia Togni, Michele Furlani, Alessia Belloni, Nicole Riberti, Valentina Notarstefano, Elisabetta Giorgini, Corrado Rubini, Andrea Santarelli, and Marco Mascitti. IJOS – Under revision - **CONFIDENTIAL**

Article

The Symmetric 3D Organization of Connective Tissue around Implant Abutment: A Key-Issue to Prevent Bone Resorption

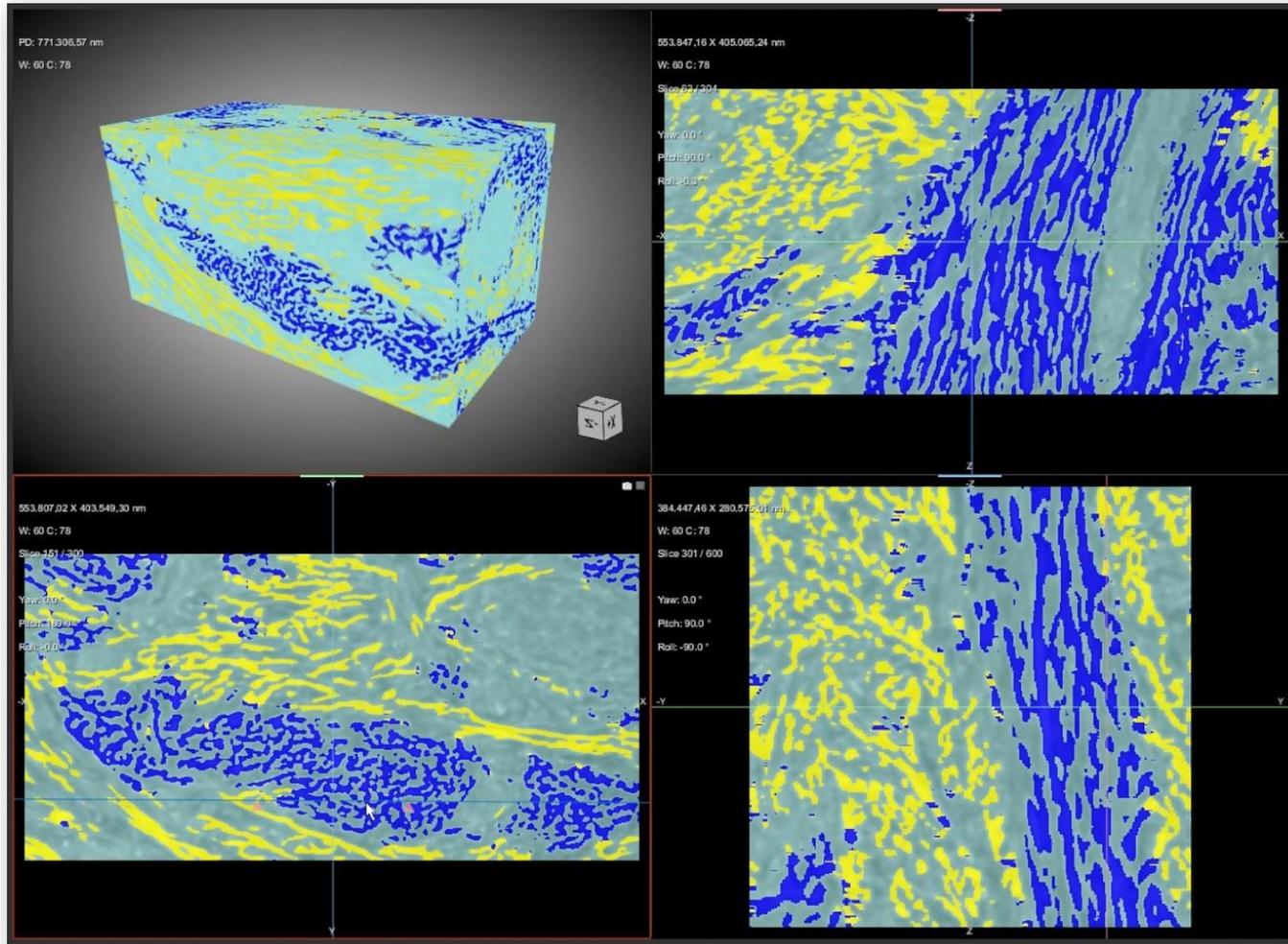
Giovanna Iezzi ¹, Francesca Di Lillo ², Michele Furlani ³, Marco Degidi ⁴, Adriano Piattelli ^{1,5,6,7}
and Alessandra Giuliani ^{3,4}



Intelligenza Artificiale!



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Manuscript ID: applsci-2287065

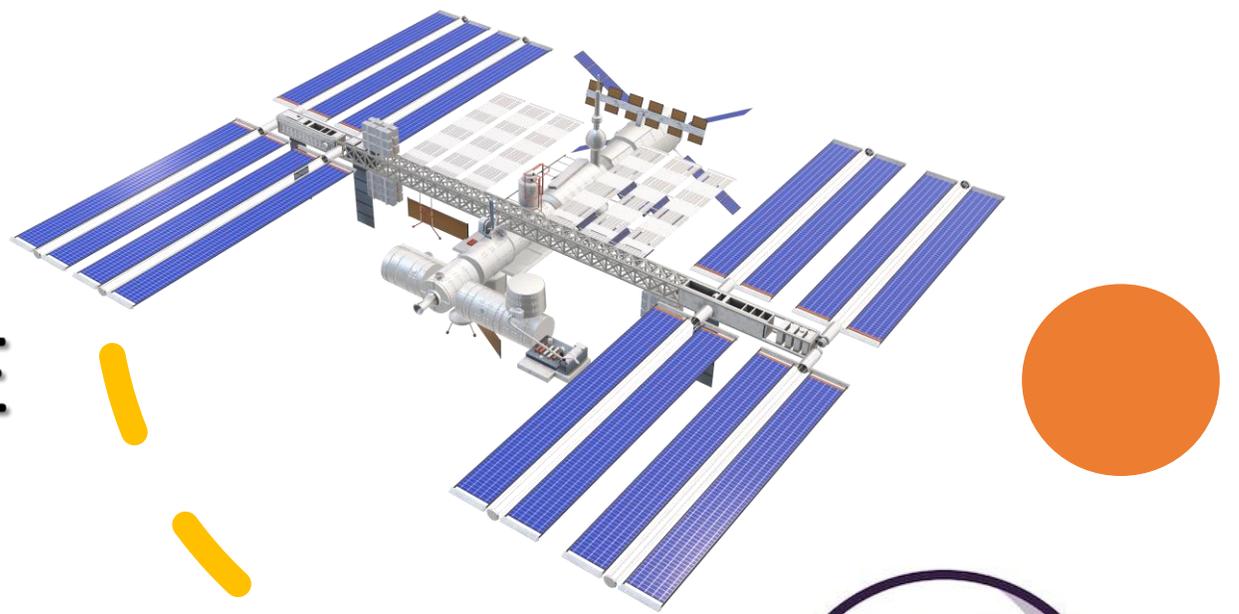
Deep learning for Microstructural Characterization of Synchrotron Radiation-based Collagen Bundles Imaging in Peri-Implant Soft Tissues

By Nicole Riberti, Michele Furlani, Emira D'Amico, Luca Comuzzi, Adriano Piattelli, Giovanna Iezzi, Alessandra Giuliani

Applied Sciences – Under Revision

CONFIDENTIAL

CHALLENGES in SPACE



- ✓ **la guarigione delle ferite è rallentata e compromessa** nello spazio a causa della microgravità
- ✓ man mano che gli esseri umani si avventurano più in profondità nello spazio, con missioni più lunghe e capacità mediche limitate, **lo studio dei meccanismi di guarigione delle ferite e delle fibrosi** diventa prioritario nella ricerca spaziale



GRAZIE per l'attenzione !