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Giovani Ricercatori BIOMORF 2025

*Summer Edition*

5 giugno 2025

Centro Congressi Policlinico "G. Martino" Messina



**BIOMORF**

DIPARTIMENTO DI SCIENZE BIOMEDICHE,  
ODONTOIATRICHE E DELLE IMMAGINI  
MORFOLOGICHE E FUNZIONALI



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## *Proceedings*

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## Summer Edition

5 giugno 2025 - Centro Congressi Policlinico "G. Martino" Messina

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Abstract 1

## Cognitive-affective models in the study of technology addictions

**<sup>1\*</sup>Federica Arena, <sup>2</sup>Clara Lombardo, <sup>1</sup>Francesca Godfrey, <sup>1</sup>Alessandra Accetta, <sup>3</sup>Federica Zuccalà, <sup>4</sup>Giulia Esposito, <sup>1</sup>Maria Rosaria Anna Muscatello, <sup>1</sup>Carmela Mento**

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**Key-Words:** techno-addiction; affective temperaments; working memory

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**Introducing Member :** Alessandra Bitto

Recent research suggests that internet addiction involves not only overexposure to digital stimuli but also specific emotional and cognitive profiles, including high emotional reactivity, novelty seeking, reward sensitivity, and executive dysfunctions. This study aims to examine the role of cognitive-affective models, specifically affective temperaments and working memory, in individual vulnerability to technology addiction. The chosen method was to create an online survey using Google Form and share it on various social networks (WhatsApp, Facebook, Instagram). The assessment tools included the Internet Addiction Test (IAT), the Working Memory Questionnaire (WMQ), the Temperament Evaluation of Memphis, Pisa, Paris, and San Diego-Autoquestionnaire (TEMPS-A), and the BRIEF-COPE inventory.

Participants with moderate internet addiction exhibited significant deficits in working memory across domains such as information storage, attention, and executive control. Furthermore, they showed a higher prevalence of irritable, depressive, and cyclothymic temperaments compared to those with mild addiction. In behavior, this group reported more frequent use of dysfunctional coping strategies, indicating reduced adaptive regulation of challenges.

The findings underscore the centrality of emotional and cognitive factors in understanding internet addiction. Specifically, working memory impairments and the prevalence of certain affective temperaments highlight the need to conceptualize technology addiction within a broader framework that integrates emotional, cognitive, and adaptive dimensions, beyond mere behavioral manifestations.

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*Abstract 2*

## A compact measurement system for continuous monitoring of skin electrical impedance

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**Key-Words:** Biomedical Sensors; Skin Electrical Impedance; Impedance Spectroscopy; Flexible electronics; Wearable Devices.

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**Introducing Member:** Alessandra Bitto

This research involves the design, development, and characterization of a compact electronic board for biomedical applications, specifically for continuous, non-invasive monitoring of skin electrical impedance. The proposed prototype employs the Arduino Nicla Sense ME embedded system, suitable for wearable applications, demanding battery and Bluetooth Low Energy operations, small dimensions and high performance.

Measurements are performed using the Analog Devices AD5933, a 12-Bit Impedance Converter capable of measuring impedance in the range of 100  $\Omega$  to 10 M $\Omega$  and connected to the Arduino Nicla via the I2C protocol. The compact system is completed with a 48.64 x 24.34 mm<sup>2</sup> custom electronic board, manufactured on a FR4 substrate and two electrodes for the acquisition of skin electrical impedance, enabling direct interfacing with the body. The realized device is equipped with a local data storage on system using an SD card, allowing both real-time monitoring and offline analysis.

Calibration was conducted with the ModuLab XM MTS system, systematically varying sample impedances to assess the accuracy of the measurements. The obtained measurements successfully confirm the validity of the developed electronic board. Owing to its structural flexibility and modularity, the proposed prototype can be fabricated on a flexible polyimide substrate with an onboard Nordic Semiconductor nRF52832 microcontroller replacing the Arduino Nicla, thereby ensuring smaller dimensions, excellent adaptability to the patient's body, comfort during extended use, and minimal interference with daily activities.

The achieved findings represent a significant improvement toward wearable technologies in personalized and preventive medicine, enabling continuous and reliable skin electrical impedance monitoring.

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**Abstract 3**

# **Toward precision medicine in miscarriage: a two-phase study of genetic etiologies in recurrent pregnancy loss**

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**Key-Words:** Recurrent pregnancy loss; Chromosomal abnormalities; Whole-exome sequencing; Genetic diagnosis; Multidisciplinary approach.

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**Introducing Member:** Alessandra Bitto

Spontaneous pregnancy loss is the most frequent complication of gestation, affecting approximately 15–20% of recognized pregnancies. Although up to 50% of miscarriages are linked to chromosomal anomalies primarily autosomal trisomies, monosomy X, and polyploidy — many cases remain unexplained even after standard cytogenetic analysis. Traditional approaches include parental karyotyping and chromosomal microarray analysis of products of conception (POC). However, advances in genetic testing, particularly whole-exome sequencing (WES), offer new opportunities for identifying single-gene disorders that may underline unexplained losses. This study aims to establish a comprehensive diagnostic workflow for recurrent pregnancy loss (RPL) by integrating conventional cytogenetic analyses with next-generation sequencing.

In Phase 1, couples experiencing RPL undergo POC analysis to identify chromosomal abnormalities, with careful exclusion of maternal contamination and confined placental mosaicism.

Phase 2 expands the evaluation to include clinical history, physical assessment, and reproductive genetic testing (Carrier Screening and Expanded Carrier Screening) to assess the couple's reproductive risk profile.

Preliminary data show that approximately 65% of analyzed POC samples return negative results for chromosomal anomalies, highlighting a need for deeper genomic investigation. In such cases, trio-based WES is initiated to identify potential monogenic etiologies. These findings underscore the importance of moving beyond cytogenetic testing alone.

Our integrative approach not only enhances diagnostic yield but also supports informed reproductive decision-making. Ultimately, this study contributes to the development of standardized protocols aimed at mitigating the emotional burden of miscarriage and guiding couples toward successful pregnancies through personalized medicine.

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**Abstract 4**

# **Mandibular advancement devices for coexisting obstructive sleep apnea and temporomandibular disorders: a retrospective study on clinical and quality of life outcomes**

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**Key-Words:** Obstructive Sleep Apnea Syndrome, Temporomandibular Disorders, Mandibular Advancement Devices, Sleep Quality.

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**Introducing Member:** Alessandra Bitto

This retrospective study aimed to evaluate whether the use of Mandibular Advancement Devices (MADs) in patients with Obstructive Sleep Apnea Syndrome (OSAS) and Temporomandibular Disorders (TMD) resulted in a reduction or exacerbation of TMD symptoms. Additionally, the study assessed the impact of this treatment on patients' quality of life. The clinical records of 25 patients (mean age  $55.3 \pm 6.25$  years) treated at the Gnathology Center of the University Hospital of Messina were reviewed.

Patients underwent comprehensive screening, including clinical and instrumental examinations, polysomnography, and questionnaires to assess TMD symptoms, daytime sleepiness, and quality of life. All patients were treated with custom-made MADs. Descriptive statistics revealed significant improvements in key indicators: a reduction in the Apnea-Hypopnea Index (AHI) from  $28.27 \pm 9.22$  to  $8.13 \pm 4.43$ , a decrease in the Epworth Sleepiness Scale (ESS) score from  $8.76 \pm 3.50$  to  $3.71 \pm 1.87$ , and a reduction in the Fonseca Anamnestic Index (TMD) score from  $33.80 \pm 18.02$  to  $11.76 \pm 9.01$ .

Quality of life, measured by the SF-36 questionnaire, improved significantly from  $93.71 \pm 6.93$  to  $109.28 \pm 6.19$ . Statistical analyses (paired ttests, repeated-measures ANOVA, and linear regression) confirmed significant improvements. The regression analysis demonstrated a strong correlation between AHI reduction and TMD symptom improvement ( $R^2 = 0.95$ ), and a moderate-to-strong correlation with quality of life improvement ( $R^2 = 0.66$ ). In conclusion, MAD treatment for OSAS significantly improved both sleep-related symptoms and TMD symptoms, highlighting the multidisciplinary nature of these conditions, which often coexist with comorbidities and require an integrated treatment approach.

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*Abstract 5*

## **CAD-CAM customized device for decompression of large odontogenic cysts: digital evaluation of clinical outcomes**

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**Key-Words:** digital, CAD-CAM, decompression, cysts of the jaws

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**Introducing Member:** Alessandra Bitto

The management of extensive odontogenic cystic lesions in the jaws remains a significant clinical challenge in oral surgery requiring methods that minimize patient discomfort and optimize therapeutic outcomes.

This study analyzes the outcome of utilizing an innovative decompression device for odontogenic cyst management, specifically designed and manufactured using CAD-CAM technologies, aimed at improving patient compliance, reducing morbidity.

The effectiveness of the treatment was evaluated through volumetric analysis by segmentation of DICOM files from baseline to a maximum of 36 months of follow-ups. The volumetric analysis showed significant lesion size reduction, confirming the device's efficacy in clinical practice, other outcomes reported by the patient were improved comfort, easier hygiene management, and reduced frequency of clinical visits compared to traditional decompression methods.

This research highlights the potential of tailored CAD-CAM decompression devices to significantly enhance patient experiences in managing odontogenic jaw cysts and reduce dimensions of odontogenic cyst lesion.

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**Abstract 6**

## **Effects of Ticagrelor and Prasugrel on $\beta$ -Catenin and DKK1 pathways in STEMI patients undergoing primary PCI: insights from the BETA-MI study**

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**Key-Words:** WNT/ $\beta$ -catenin signaling, P2Y12 inhibitors, Cardiac Fibrosis

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**Introducing Member:** Alessandra Bitto

Dual antiplatelet therapy (DAPT), combining aspirin with a potent P2Y12 inhibitor (e.g., ticagrelor or prasugrel), is standard care for ST-segment elevation myocardial infarction (STEMI) requiring percutaneous coronary intervention (PCI). Fibrosis is central to cardiac repair post-myocardial infarction (MI), with the WNT/ $\beta$ -catenin pathway and its antagonist DKK1 playing important but understudied roles. The differential effects of P2Y12 inhibitors on these pathways remain unclear.

We conducted a single-center prospective study (BETA-MI, NCT05122741) to assess the effects of ticagrelor and prasugrel on  $\beta$ -catenin and DKK1 pathways in STEMI patients, and to evaluate potential clinical implications.

Forty STEMI patients undergoing PCI received DAPT with either ticagrelor or prasugrel.  $\beta$ -catenin and DKK1 levels were assessed using ELISA and qPCR at baseline, post-PCI, 3 days, discharge, and 45-day follow-up. Baseline and angiographic characteristics were comparable between groups (ticagrelor: 62 $\pm$ 8 years, 81% male; prasugrel: 61 $\pm$ 9 years, 89% male), with no significant differences in cardiovascular events during hospitalization or at 45 days. No differences were found in  $\beta$ -catenin or DKK1 levels between treatment groups at any timepoint ( $p > 0.05$ ).

In STEMI patients treated with primary PCI, DAPT with ticagrelor or prasugrel did not differentially affect  $\beta$ -catenin or DKK1 pathways. These findings suggest that choice of P2Y12 inhibitor may not influence early post-infarction molecular remodeling via these targets.

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**Abstract 7**

## **Boosting Doxorubicin efficacy with graphene quantum dots in breast cancer cells**

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**Key-Words:** GQDs; drug delivery; Doxorubicin

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**Introducing Member:** Alessandra Bitto

Graphene quantum dots are revolutionizing the field of biomedicine, since they are suitable for tumour-targeted drug delivery, enabling it to obtain a higher drug concentration at lower doses.

GQDs allow a reduction to just 20% of the effective dose —one-quarter of the standard dosage— while still achieving impressive therapeutic outcomes. This reduction preserves efficacy and minimizes adverse effects, positioning GQDs as a groundbreaking solution for safer and more effective cancer therapies. Moreover, drug delivery can be observed thanks to GQDs fluorescence, which allows tracking their internalization.

In this *in vitro* model of breast cancer (MCF-7), we aimed to understand if functionalized GQDs can provide a better delivery of Doxorubicin in terms of time and intracellular concentration to reduce dosage. Biotin and Riboflavin have also been added to the functionalization of GQDs, as known targeting ligands for cancer cells, have also been added to the functionalization of GQDS to test if they could enhance GQD-DOXO efficacy.

The cytostatic and cytotoxic effects of Doxorubicin have been evaluated in MCF-7, treated with the drug alone (12.5 – 10 µg/mL) or conjugated with GQDs (1.25 – 10 µg/mL). Drug internalization, cell survival and expression of mRNA related to cellular death (Bax, Bcl-2) and proliferation (Ciclina D1, CDK4, CDK6) were studied at 24 hours.

These findings reveal that the administration of Doxorubicin through GQDs allows a faster internalization at lower doses. In addition, an up-regulation of molecular targets of cell death and a down-regulation of positive regulators of cell cycle in MCF7 treated with GQD-DOXO.

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**Abstract 8**

## **Impact of Nd:YAG laser-induced pitting on light path through intraocular lenses**

**<sup>1\*</sup>Laura De Luca, <sup>1</sup>Alessandro Meduri, <sup>1</sup>Giuseppe Acri, <sup>1</sup>Barbara Testagrossa, <sup>1</sup>Elisa Ruello, <sup>1</sup>Pasquale Aragona**

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Key-Words:?????

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Introducing Member: Alessandra Bitto

Neodymium-doped Yttrium-Aluminum-Garnet (Nd:YAG) laser capsulotomy is a routine procedure following cataract surgery, for posterior capsule opacification (PCO). However, inadvertent contact of the laser with intraocular lenses (IOLs) may lead to focal surface damage, commonly referred to as “pitting,” raising concerns about potential optical consequences.

This experimental study aimed to assess how Nd:YAG laser-induced alterations affect light passage through the IOL, possibly altering perception at the retinal level, using virgin IOLs as a reference. Hydrophobic acrylic (ZEISS CT LUCIA) and hydrophilic acrylic (AcrySof IQ, Alcon) IOLs were exposed to 5, 10, and 15 laser shots using a Zeiss VISULAS YAG III system laser system. Each lens was mounted on a custom-designed holder and exposed to the PhysioGo.

Lite laser system, with subsequent thermal interactions monitored via infrared imaging using a FLIR T440bx thermal camera. Even minimal laser exposure led to IOL surface damage that caused deflection of transmitted light rays, resulting in off-axis light dispersion mimicking visual disturbances reported post-procedure from patients that presented with IOL laser-induced pits. These optical aberrations occurred independently from pulse number and lens material, indicating that focal precision during laser capsulotomy is critical.

This study underscores the importance of minimizing collateral IOL exposure during posterior capsule treatment, as unintended surface alterations may compromise lens integrity and visual outcomes.

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*Abstract 9*

## **Biomechanical assessment of immediate-loaded dental implants using 3D finite element analysis**

**<sup>1\*</sup>Fulvia Galletti, <sup>1</sup>Vincenzo Ronsivalle, <sup>1</sup>Francesco Catalano, <sup>1</sup>Gabriele Cervino**

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**Key-Words:** immediate loading; finite element analysis; dental implant biomechanics; stress distribution

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**Introducing Member:** Alessandra Bitto

This research investigates the stress distribution around a titanium dental implant subjected to immediate functional loading, through the use of three-dimensional finite element analysis (FEA). A virtual model consisting of a 10 mm × 4 mm titanium implant embedded within a simulated cortical bone volume (20 mm<sup>3</sup>) was developed and analyzed using the SimScale® platform under static loading conditions.

A vertical occlusal force of 400 N was applied, and the model featured a frictionless interface to mimic immediate loading scenarios. All materials were considered isotropic and linearly elastic. Peak von Mises stress, measured at the crestal bone-implant junction, reached 40.88 Pa, while the mean stress in the surrounding bone was 0.4567 Pa, with negligible stress observed apically.

All stress levels remained within acceptable biomechanical limits. The findings reinforce the potential viability of immediate loading protocols when implant design and placement are optimized. The FEA approach demonstrates its utility in preclinical evaluation of implant performance and peri-implant stress patterns.

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Abstract 10

## Fractional flow reserve from computed tomography angiography: a reliable tool for identifying vessel-specific ischemia in coronary artery disease

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**Key-Words:** Artificial Intelligence, Coronary Artery Disease, Fractional Flow Reserve, Computed Tomography Angiography

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**Introducing Member:** Alessandra Bitto

Invasive intracoronary pressure measurements, such as Fractional Flow Reserve (FFR) and Instantaneous Wave-Free Ratio (iFR), are the gold standard for assessing the hemodynamic significance of coronary artery stenoses.

Recently, artificial intelligence (AI) based methods have enabled non-invasive estimation of FFR from Coronary Computed Tomography Angiography (CCTA), conventionally known as FFR derived from computed tomography (FFR-CT). This study evaluates the diagnostic performance of an AI-based FFR-CT software (CorEx, Spimed) for detecting vessel-specific ischemia in patients with coronary artery disease, using Invasive Coronary Angiography (ICA) and pressure-based measurements as reference standards.

The retrospective multicenter analysis included 243 coronary vessels from 81 patients (20 females, 61 males) who underwent both CCTA and ICA within an average interval of 50 days. AI-based FFR-CT values  $\leq 0.80$  were considered indicative of hemodynamically significant stenosis. Invasive FFR or iFR values served as the reference standard. On a per-patient basis, the model demonstrated high diagnostic accuracy, with an Area Under the Curve (AUC) of 0.857 (95% Confidence Interval [CI]: 0.762–0.925;  $p < 0.0001$ ), sensitivity of 96.4% (95% CI: 87.9–99.6%), and specificity of 75.0% (95% CI: 53.3–90.2%).

Kappa agreement was substantial ( $\kappa = 0.751$ ; 95% CI: 0.590–0.913). On a per-vessel basis, AUC was 0.793 (95% CI: 0.737–0.842), with sensitivity of 66.6% (95% CI: 56.1–76.1%) and specificity of 92.0% (95% CI: 86.4–95.8%). Kappa agreement was 0.61 (95% CI: 0.507–0.714). These findings support the AI-based FFR-CT model as a reliable non-invasive alternative to invasive physiological assessment of vessel-specific coronary ischemia.

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**Abstract 11**

# Microplastics in hospital wastewater and human health implications

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**Key-Words:** Wastewater, Microplastics, Environmental corona, Environmental ageing, Citotoxicity

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**Introducing Member :** Alessandra Bitto

Microplastics (MPs) are pervasive environmental pollutants whose concentrations are expected to rise, posing growing threats to both ecosystems and human health. Due to environmental ageing processes, MPs become more reactive, increasing their capacity to adsorb various contaminants from environmental matrices, allowing their re-entering in the trophic chain.

This study investigates the adsorption behavior and cytotoxicity of 1 µm polystyrene microplastics (mPS), both virgin (v-mPS) and home-aged (ox-mPS), following exposure to hospital wastewater. Hydrodynamic diameter measurements and FTIR analysis revealed significant adsorption of organic and inorganic substances from v- and ox mPS, suggesting the formation of an environmental corona and confirming the oxidable load adsorbed to mPS (assessed by COD and PI).

Wastewater-v-mPS exhibited a higher increase in particle size and a thicker coating due to their hydrophobic nature and affinity for apolar or weakly polar compounds such as fatty acids and aliphatic hydrocarbons. Conversely, ww-ox-mPS, enriched with polar functional groups (e.g., hydroxyl, carboxyl, etc.), displayed a more uniform and moderate increase in diameter. Environmental corona included alcohols, phenols, carboxylic acids and esters or aldehydes. Zeta potential measurements indicated significant adsorption of negatively charged species on v-mPS, enhancing surface reactivity.

In vitro cytotoxicity assays using human colorectal cells showed increased cell mortality, particularly following exposure to ww-v-mPS, highlighting potential risks from ingestion of contaminated food. Overall, the findings underscore the importance of understanding microplastic interactions in wastewater and their implications for human exposure.

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**Abstract 12**

## **WNT/ $\beta$ -Catenin pathway in acute myocardial infarction: a prospective cohort study (BETA-MI STUDY)**

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**Key-Words:** Myocardial infarction, Wnt/ $\beta$ -catenin pathway, Cardiac remodeling

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Heart failure (HF) remains a major complication after myocardial infarction (MI), largely driven by post-infarction fibrosis, which affects myocardial function and electrical conduction. The WNT/ $\beta$ -catenin signaling pathway and adenosine receptors have emerged as potential contributors to cardiac fibrosis and targets for intervention. This study investigated the role of WNT/ $\beta$ -catenin signaling and DKK1 in post-MI remodeling, correlating molecular patterns with clinical outcomes.

This single-center observational cohort study enrolled 40 patients with ST-segment elevation myocardial infarction (STEMI) undergoing percutaneous coronary intervention (PCI). A control group of 10 patients with chronic coronary syndrome (CCS), matched for sex, age, and risk factors, and undergoing PCI for the first time, was also included.  $\beta$ -catenin and DKK1 levels were assessed using ELISA and qPCR on peripheral blood samples collected at baseline, 3 days post-admission, discharge, and 45-day follow-up. Echocardiogram and cardiac magnetic resonance (CMR) were performed post-PCI, at discharge, and at follow-up to evaluate cardiac remodeling.

The average patient age was 62 years ( $\pm 8$ ), with 82% male. In STEMI patients, DKK1 qPCR showed a significant increase over time ( $p = 0.0144$ ). Intra-hospital  $\beta$ -catenin ELISA levels significantly predicted improvement in LVEF at follow-up ( $p = 0.0278$  for pre-PCI levels). No molecular parameters predicted NT-proBNP changes. Compared to CCS patients, STEMI patients had significantly higher  $\beta$ -catenin ELISA levels at all shared timepoints ( $p < 0.0001$ ). These findings suggest that  $\beta$ -catenin is elevated post-STEMI and may serve as a prognostic marker of functional recovery.

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References must not be numbered in the text but inserted here according to the following format:

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Abstract 13

# Topology optimization of bio-inspired lattice structures through energy methods

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**Key-Words:** Lattice structures, Topology Optimization, Energy Methods

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Additive manufacturing (AM) enables the fabrication of structural components using various printing strategies and materials, starting from a 3D model. This process allows for the creation of complex geometries and intricate structures. Lattice structures are a class of periodic or aperiodic geometries characterized by low weight and customizable mechanical properties, making them ideal for advanced applications in additive manufacturing.

Lattice structures enable the optimization of mechanical properties and allow for the tailoring of component stiffness to specific requirements. Drawing inspiration from biological systems, bio-inspired designs have shown significant advancements over conventional lightweight structures. In fact, many of today's lattice architectures are derived from nature. For example, the triply periodic minimal surface (TPMS) gyroid has been identified in the wing scales of the butterfly species *C. rubi*, while diamond-like surfaces appear in the exoskeletons of beetles and weevils.

Due to their complex geometries, often featuring sharp notches and discontinuities, lattice structures require analysis through Energy Methods. These approaches consider local parameters such as Strain Energy Density (SED), Notch Stress Intensity Factor (NSIF), and the Peak Stress Method (PSM). Finite Element Method (FEM) simulations are performed to compute these parameters. Machine learning algorithms are then employed to compare different unit cells and identify the optimal configuration based on a defined objective function. This function typically incorporates mechanical characteristics of the component, including weight, stiffness, production cost, and local stress parameters.

The resulting optimal design is subsequently validated through experimental testing using non-contact measurement techniques such as Digital Image Correlation and Infrared Thermography.

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**Abstract 14**

## **Bacterial population and failure of the empiric regimen in patients with medication-related osteonecrosis of the jaw. time to rethink the bone microbiological sampling strategy?**

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**Key-Words:** Medication related osteonecrosis of the jaw; bone specimen; antibiotic therapy; antimicrobial resistance.

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Mature bacterial biofilms are now identified as potential critical trigger in the pathogenesis of medication-related osteonecrosis of the jaw (MRONJ) which can also have a negative influence on MRONJ surgical treatment outcome. Clinically, MRONJ is characterized by necrotic bone associated with or without inflammatory signs and purulent drainage.

Systemic antibiotics are often used in conjunction with osseous resective surgery and are useful at all stages; especially antibiotic therapy is it is an important treatment option when surgery is not possible.

The most widely used antibiotics for the initial antibiotic treatment consists in  $\beta$ -lactams however the empiric regimen showed low success rate and the progression of MRONJ when only conservative therapy is performed.

Resistance mechanisms that inactivate antibiotics are widespread, providing both acquired and intrinsic resistance to some of the most widely used antibiotics including  $\beta$ -lactams. In patients with resistant infection the identification of the causative pathogen is usually performed through oral swab or bone biopsy with tissue culture and appropriate targeted antibiotics are administered after microbiological analysis.

We promote multidisciplinary infection-related care in the surgical pathway for personalized treatment approaches. In the age of antibiotic resistance (AMR), it is imperative to target the multiple pathogen species in order to mitigate AMR. Furthermore, we argue that to fully understand the evolution of AMR we must study the emergence of resistance within the context of microbial communities.

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**Abstract 15****Comparative outcomes of MIPO vs ESIN in complex pediatric tibial fractures (AO 42B-C and 43B-C): a retrospective cohort study****<sup>1</sup>Giovanni Marrara, <sup>1\*</sup>Gabriele Giuca, <sup>1</sup>Daniela Alessia Marletta, <sup>1</sup>Ilaria Sanzarello, <sup>1</sup>Matteo Nanni, <sup>1</sup>Biagio Zampogna, <sup>1</sup>Danilo Leonetti****<sup>1</sup> Department of Biomedical and Dental Sciences and Morphofunctional Imaging (BIOMORF), University of Messina, Italy****Key-Words:** Pediatric Tibial Fractures, MIPO, ESIN, Complex Fractures, Minimally Invasive Surgery.**Corresponding Author:** Gabriele Giuca - gabgiuca@unime.it  
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Elastic Stable Intramedullary Nailing (ESIN) is a common treatment for pediatric tibial fractures, especially in standard diaphyseal fracture patterns and normal body mass index (BMI). However, ESIN may be technically limited in complex fracture morphologies (AO 42B-C, 43B-C) and in heavier children. Minimally Invasive Plate Osteosynthesis (MIPO), a technique widely embraced in adult orthopedic trauma, may provide more robust fixation in these challenging scenarios through mini-incisions, indirect reduction strategies, and a stable “sliding plate” construct that preserves fracture biology.

This study compared the clinical and radiographic outcomes of MIPO versus ESIN in children with AO 42B-C or 43B-C tibial fractures, paying particular attention to outcomes. A single-center, retrospective cohort design was employed. We evaluated 115 pediatric patients (ages 6–15) with tibial fractures classified as AO 42B-C or 43B-C between January 2016 and December 2024.

Fifty-one underwent MIPO, and 64 received ESIN. Primary outcomes included time to radiographic union and rates of major complications (deep infection, refracture, hardware failure). Secondary parameters were residual deformity ( $>5^\circ$ ), unplanned reoperations, time to sports resumption, and the feasibility of using advanced MIPO techniques for indirect reduction. MIPO led to a significantly shorter median time to union (11 vs. 15 weeks in ESIN,  $p < 0.001$ ) and lower major complication rates (24% vs. 42%,  $p = 0.04$ ). Overweight patients (BMI  $> 24$ ) benefited substantially from MIPO, demonstrating favorable stability and fewer complications.

The indirect reduction tactics and “sliding plate” approach facilitated anatomic alignment without direct fracture exposure. Early weight-bearing was feasible in most MIPO cases, and no additional immobilization was typically required. MIPO appears to outperform ESIN in challenging pediatric tibial fractures, particularly at higher BMI, by allowing advanced indirect reduction techniques, robust fixation, and early functional recovery. Prospective, multicenter studies are recommended to corroborate these findings.

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**Abstract 16**

## **A multidisciplinary approach in study of human remains recovered from the sea: the post mortem submersion interval.**

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**Key-Words:** post mortem submersion interval (PMSI); human identification; dental age estimation; DNA typing

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The forensic investigation of human remains recovered from seawater presents considerable challenges, primarily due to the advanced decomposition processes that impede the assessment of submersion and postmortem interval, victim identification, cause and manner of death and the geographic provenance of the event. Aquatic-induced morphological alterations substantially limit the application of conventional forensic protocols, highlighting the need for alternative diagnostic indicators.

This study analyzed four bodies in advanced decomposition, recovered along the northeastern Sicilian coastline and adjacent marine areas at different times and latitudes between spring and summer 2024. Myocardial and liver tissue samples were collected from three subjects for genetic analysis. In two cases, crustacean colonies were morphologically identified. All individuals underwent odontological examinations, including intraoral radiographs of the lower third molars. DNA analysis was performed using PCR (GlobalFiler kit) and SEQ Studio.

Oceanographic models using OpenDrift (Norwegian Meteorological Institute) and environmental data from Copernicus Marine Data Store were applied to reconstruct possible drift trajectories. Anthropometric analysis provided biological profiles (age, sex, constitution). Partial genetic profiles were obtained. Crustacean colonization timing and life cycles allowed estimation of submersion intervals. Drift modeling aligned with biological and geolocational data, linked all four individuals to a single maritime event.

The multidisciplinary approach, combining geological, odontological-anthropological, genetic, and marine biological methodologies, proved effectiveness for victim identification, estimation of immersion time, and reconstruction of drift pathways offering innovative investigative tools for marine forensic practice.

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**Abstract 17**

## **Impact of night shift work on breast cancer risk and circadian gene expression in female healthcare workers**

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**Key-Words:** Breast cancer, Night shift work, Circadian rhythm, Clock genes, Occupational health

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Breast cancer (BC) is the second leading cause of cancer-related mortality in women. Chronic exposure to night shift work (NSW) is associated with an increased risk of BC, likely due to disruption of circadian rhythms and reduced melatonin production, a neurohormone with anti-estrogenic and antioxidant properties. The International Agency for Research on Cancer classifies NSW as probably carcinogenic to humans. Previous studies by our group revealed differential expression of 12 clock genes in breast tissue of BC patients exposed to NSW, suggesting a link between circadian disruption and tumorigenesis.

This study aims to assess the association between NSW and BC in female healthcare workers, evaluating modifiable risk factors (sleep quality, lifestyle), work ability, metabolic parameters, and clock gene expression as early susceptibility markers. In phase one, we analyzed medical records of 1,191 female healthcare workers at a hospital in southern Italy, focusing on NSW exposure and BC diagnosis. In phase two, 400 healthy workers (exposed and unexposed to NSW) are being recruited during health surveillance.

Data collection includes validated questionnaires (Work Ability Index, Pittsburgh Sleep Quality Index, Epworth Sleepiness Scale, MEDI-lite), blood tests (complete blood count, GOT, GGT, cholesterol, triglycerides, vitamin D3), and clock gene expression in Peripheral Blood Mononuclear Cells via quantitative PCR. Among the records, 67% involved night workers, with 35 BC cases identified, 17 of which had performed night shifts. This prevalence (3%) aligns with literature data.

Our multidisciplinary approach may help identify early markers of BC risk and guide preventive strategies for shift-working populations.

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**Abstract 18**

## **Neurofilaments in tears as biomarkers of neuronal degeneration in diabetic patients**

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**Key-Words:** Neurofilaments; Diabetic Retinopathy; Corneal nerve; Diabetic Neuropathy; Neurodegeneration.

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Neurodegeneration in diabetic patients involves both the retinal nerve fiber layer (RNFL) and the corneal nerve plexus and could precede the occurrence of diabetic retinopathy (DR) or corneal diabetic neuropathy.

Neurofilaments, essential components of nerve cell structures, have become promising biomarkers for neurodegenerative diseases. The aim of this study is to evaluate the presence of neurofilaments in the tears of diabetic patients and their correlation with corneal sub-basal nerve and RNFL alterations.

Twenty-four eyes of 12 patients with type 2 diabetes were examined in this study and compared with 24 eyes of 12 healthy patients. The Schirmer I test was performed to collect tear samples and detect levels of Neurofilament light chain (NF-L) using the specific Single Molecule Array (SIMOA) platform (Quanterix). In vivo confocal microscopy (ICVM) was performed to evaluate the corneal sub-basal nerve plexus. SS-OCT was performed to evaluate the thickness of the RNFL and ganglion cell complex (GCC).

Our results demonstrated significantly elevated tear NF-L levels in diabetic patients compared to non-diabetic controls (265.2 pg/ml vs. 31.51 pg/ml). Furthermore, a strong inverse correlation was observed between tear NF-L levels and RNFL and GCC thickness in diabetic patients (GCC/NF-L=r -0.7; RNFL/NF-L=r -0.8). The results of our study suggest that increased NF-L in tears reflects retinal neurodegeneration and inversely correlates with RNFL and GCC thinning, highlighting its potential as a biomarker for early detection and monitoring of diabetic retinal neurodegeneration.

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**Abstract 19**

# Polynucleotides as medical devices in dental tissue regeneration: a scoping review of current evidence and future perspectives

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**Key-Words:** polynucleotides; periodontal regeneration; cellular response; tissue engineering; medical devices in dentistry

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The aim of this research is to explore the efficacy of polynucleotides (PN) in the field of regenerative dentistry, with particular reference to their action on specific cell populations involved in periodontal regeneration, such as fibroblasts, osteoblasts and cementoblasts.

A scoping review of the scientific literature was carried out through an in-depth search of the main international databases - PubMed, Google Scholar and Scopus - published between 2000 and 2025, using advanced searches with combinations of specific keywords, such as “polynucleotides AND bone healing”, “polynucleotides AND tissue regeneration”, and “polynucleotides AND fibroblasts/osteoblasts/cementoblasts proliferation”, which returned a total of 1150 articles. Of these, five relevant studies were selected, including pre-clinical trials conducted both in vitro and in vivo.

The included studies focused on the action of PN used as medical devices, analysing their regenerative effect in terms of cell proliferation, extracellular matrix synthesis and bone formation. The results confirm the high potential of PN in promoting the vitality and metabolic activity of fibroblasts and osteoblasts, contributing to collagen synthesis and osteogenic differentiation respectively.

Moreover, their combination with hyaluronic acid has been shown to amplify their benefits, suggesting an interesting synergy in soft tissue repair. However, the action of PN on cementoblasts is still completely unexplored. The investigation of this cell lineage represents a promising future direction for the development of regenerative strategies in dentistry. In conclusion, PN show significant clinical potential, but require more extensive and targeted clinical studies to validate their efficacy, safety and new cellular applications.

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Abstract 20

## Phantom-based evaluation of spectral CT algorithms for contrast agent differentiation

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**Key-Words:** dual-energy CT, spectral reconstruction algorithms, material decomposition, gadolinium.

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This study evaluated the capability of Electron Density Weighting (EDW), Z-effective (Z-eff), and Virtual Non-Contrast (VNC) spectral reconstructions in distinguishing between iodine-based (Ultravist, Iopromide) and gadolinium-based (Gadovist, Gadobutrol) contrast agents. A phantom containing aqueous solutions of each contrast medium at three concentrations (4.75 mg/mL, 19 mg/mL, and 150 mg/mL), along with distilled water, was scanned using a dual-layer spectral CT system (iQon Spectral CT, Philips). Conventional, EDW, Z-eff, and VNC datasets were generated. Regions of interest (ROIs) were placed within each vial to quantify signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR), enabling assessment of contrast differentiation across reconstructions.

EDW reconstructions achieved the highest CNR values for both contrast agents at medium and high concentrations, demonstrating superior contrast resolution. Z-eff maps yielded lower CNR values than conventional Hounsfield Unit (HU) images, particularly at low concentrations, limiting their discriminatory utility. VNC reconstructions showed progressively higher CNR values with increasing gadolinium concentration and allowed for effective differentiation of gadolinium from iodine-based agents due to selective iodine suppression when compared with conventional datasets.

In summary, EDW provided the greatest overall CNR performance, while VNC reconstructions enabled reliable discrimination between iodine- and gadolinium-based contrast agents. These findings support the potential clinical utility of spectral CT for multi-contrast imaging protocols, particularly when differentiation between contrast materials is essential.

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**Abstract 21**

## **Multicenter cross-sectional study of oral health and hygiene practices among pregnant women**

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**Key-Words:** DMFT; oral health; oral hygiene practices; pregnancy

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Hormonal, vascular, and behavioral changes during pregnancy can negatively impact a woman’s oral health, resulting in conditions such as gingivitis, dental sensitivity, and caries. Although oral health is critical during pregnancy, it remains frequently overlooked.

In this study, the oral health status and hygiene practices of pregnant women attending two university hospitals in southern Italy were evaluated. A cross-sectional cohort study was conducted with 72 pregnant women. Data were collected through an anonymous questionnaire that evaluated oral hygiene habits, dental visits, and oral pathologies, followed by a clinical examination.

The examination included the assessment of the Decayed, Missing, Filled Teeth (DMFT) index and the Oral Hygiene Index (OHI) scores. Among the participants, 61% were in their 9th month of pregnancy. The mean DMFT score was 7.9, and the mean OHI score was 3.6. Only 19.4% of participants had visited a dentist in the past 6 months, while 97.2% reported brushing their teeth just once per day.

Gingival bleeding was reported by 72.2% of the women, and 38.9% experienced dental sensitivity, with both conditions worsening during pregnancy. The need for greater oral hygiene education and regular dental care during pregnancy is highlighted in this study. Integrating oral health maintenance into prenatal care programs is essential for preventing pregnancy-related oral diseases and promoting maternal and fetal well-being.

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Abstract 22

## Embedded platform for EEG and Eye-Tracking in racing helmets: neurophysiological monitoring for performance optimization

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**Key-Words:** EEG monitoring; Eye-tracking; Wearable technology; Cognitive performance; Motorcycle racing.

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Real-time monitoring of brain and visual activity in high cognitive load environments, such as motorcycle racing sessions, presents a technological challenge with direct applications in assessing rider stress, fatigue, and cognitive strategies.

This project aims to develop an embedded hardware and software platform, integrated into a racing-approved motorcycle helmet, capable of acquiring EEG signals and eye-tracking data to objectively evaluate the rider's neurophysiological state and improve performance. The developed architecture is based on a quad-core ARM Cortex-A72 Processor running at 1.5 GHz, with 8 GB of RAM and 32 GB of eMMC storage and includes Wi-Fi and Bluetooth connectivity.

The requirements of a wearable application are met by the following features, such as battery-powered operation, low power consumption and onboard processing capabilities. In the initial phase, the EPOC X – 14 Channel Wireless EEG Headset was used to develop and validate the acquisition flow. The obtained results supported the design of a more accurate and reliable system for real-time neurophysiological measurements in racing contexts.

The final system is integrated into the helmet shell, maintaining compliance with motorsport safety standards, and incorporates miniaturized EEG sensors and eye-tracking modules, that monitor the eyes to identify trajectories, braking points, and visual strategies. The combined analysis of EEG signals and eye-tracking data could allow the detection of early signs of stress and fatigue, enabling performance diagnostics and the development of personalized training protocols

This interdisciplinary project merges electronics, neuroscience, and motorsport to deliver intelligent technology for continuous cognitive and behavioral assessment in real racing conditions.

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**Abstract 23**

## **Preliminary validation of the “Theragnostics” Study: a feasibility, prospective confirmation of [<sup>68</sup>Ga]Ga-DOTATOC PET radiomics features to early predict the response of GEP-NET to PRRT with [<sup>177</sup>Lu]Lu-DOTATATE**

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**Key-Words:** Artificial Intelligence, Gastroenteropancreatic Neuroendocrine Tumor, Lutetium, RLT, Theragnostics

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Nearly 30% of neuroendocrine tumor (NET) still do not respond to peptide-receptor radionuclide therapy (PRRT). We demonstrated that two radiomics features (Skewness, Kurtosis) from baseline [<sup>68</sup>Ga]Ga-DOTATOC PET/CT were able to predict PRRT response. In this ITANET-supported feasibility validation, we applied the same algorithm/features in a prospective gastroenteropancreatic (GEP)-NET cohort. We included consecutive lesions from well-differentiated, progressive, metastatic/inoperable GEP-NET after complete [<sup>177</sup>Lu]Lu-DOTATATE PRRT from the 30.04.2020 (Institutional review board approval 668-18/20); through Slicer 3D and Pyradiomics, we placed a 2D ROI on each baseline (acquired within 3 months before PRRT) [<sup>68</sup>Ga]Ga-DOTATOC PET-positive lesion, extracting Skewness and Kurtosis as per our radiomics signature. The follow-up [<sup>68</sup>Ga]Ga-DOTATOC PET/CT performed 2 months minimum from the last PRRT, determined the disease status (progression vs. overall response rate, ORR).

We included 64 consecutive lesions (20% of 324 from [1]) from 8 patients (2/8 G1, 6/8 G2; 3/8 pancreatic NET, 5/8 midgut NET) after complete [<sup>177</sup>Lu]Lu-DOTATATE PRRT. At follow-up, 2/64 lesions were completely responding, 38/64 partially responding, 21/64 were stable, and 3/64 were progressing. At the radiomics analysis of [<sup>68</sup>Ga]Ga-DOTATOC PET performed 53.9±21.6 days before PRRT, Kurtosis was able to predict ORR with a sensitivity of 83.5%, specificity of 62.3%, almost confirming the previous results (67.2% and 75.9%); differently, Skewness reached good sensitivity (69.5% vs 80.6%) but reduced specificity (33.3% vs 67.2%).

Despite limitations, this preliminary, prospective validation supported the “Theragnostics” study results. Indeed, “Kurtosis” (“discrepancy of the considered histogram from the ordinary one”) was able to predict the ORR of GEP-NET lesions after complete [<sup>177</sup>Lu]Lu-DOTATATE PRRT.

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**Abstract 24**

# Psychological traits of bariatric surgery candidates and predictors of outcomes

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**Key-Words:** Bariatric Surgery; Body Image; Predictors; Obesity, Personalized

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Obesity is associated with a reduced life expectancy depending on the severity of the condition and the presence of comorbidities. Currently, bariatric surgery is considered one of the most effective long-term interventions for severe obesity. This study explores the psychological functioning of bariatric surgery candidates in the preoperative phase and investigates potential predictors of surgical outcomes in an Italian sample. Given the complex interaction between obesity and neuropsychological factors, we sought to identify emotional and cognitive variables associated with postoperative changes.

This retrospective, naturalistic study included 97 patients assessed before undergoing bariatric surgery at the University Hospital of Messina. A subgroup of 33 participants completed psychological questionnaires at follow-up. Assessment tools included the Beck Depression Inventory-II (BDI-II), Binge Eating Scale (BES), Body Uneasiness Test (BUT), and SF-36.

While no sex differences emerged at baseline or follow-up, surgery led to significant BMI reduction and a decrease in depressive symptoms. However, the Positive Symptom Distress Index (BUT\_PSDI) unexpectedly increased, especially in women, suggesting persistent or emerging body image distress post-surgery. Regression analysis revealed that preoperative BMI predicted postoperative BMI, while baseline BDI-II, SF-36 physical function, and role limitation scores collectively predicted post-surgical depression levels. Pre-surgical BUT\_PSDI and SF-36 physical functioning predicted post-operative body image distress.

Psychological improvements following bariatric surgery were less pronounced than expected. The persistence of body image dissatisfaction highlights the need for integrated psychological care. Identifying psychological predictors pre-surgery could help personalize treatment pathways and improve long-term outcomes in obesity management.

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Abstract 25

## Treatment of post-traumatic diaphyseal and distal tibial bone defects by distraction osteogenesis: a single centre experience

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**Key-Words:** bone transport, distraction osteogenesis, Ilizarov technique, external fixation, tibia defect

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Tibia bone defects may be the result of trauma, infection, or tumour resection. Distraction osteogenesis (DO) and Maquet techniques are currently the preferred treatments for defects larger than 5 cm.

This study presents the results obtained at our clinic using DO to treat post-traumatic tibial defects.

Between January 2019 and December 2023, 19 patients with post-traumatic defects were treated using DO. The results were evaluated using the Association for the Study and Application of the Method of Ilizarov (ASAMI) scoring system.

The mean age was found to be 32.44 years. The mean defect size was 6.4 cm (range 3.5–10.2 cm), and the mean distraction time was 18.2 weeks. Bone union time was at average 7.1 months. The mean follow-up time was 3.7 years. The mean heterometry at the final follow-up was 1.3 cm (range 0–2.7 cm). Using the ASAMI system, the functional results were excellent in eight patients, good in nine, and fair or poor in one; while the radiographic results were excellent in ten patients, good in six, fair in two, and poor in one.

The efficacy of DO has been demonstrated in the treatment of defects. The present study achieved good/excellent functional results in 84.21% of cases, which is consistent with the extant literature.

Ilizarov technique for the treatment of tibial defects has the potential to yield favourable to excellent outcomes, provided the method is performed correctly. Nevertheless, multicentre prospective studies would allow more definitive conclusions to be drawn.

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**Abstract 26**

# **Body surface area–normalized myocardial iodine concentration in spectral coronary CT angiography: toward standardized reference values in non-obstructive CAD**

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**Key-Words:** total iodine load, myocardial iodine concentration, body surface area

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Standardization of contrast-enhanced CT protocols is of particular interest in the modern era of new spectral and photon-counting CT platforms. This retrospective study evaluated myocardial iodine distribution in 45 patients without obstructive coronary artery disease (CAD) who underwent spectral coronary computed tomography angiography (CCTA).

Patients were stratified into three groups based on body weight:  $\leq 70$  kg (Group 1), 71–89 kg (Group 2), and  $\geq 90$  kg (Group 3), each including an equal number of males and females. Group 1 (mean age: 61 years; mean body mass index [BMI]: 23) received 42 g of iodine; Group 2 (mean age: 64 years; BMI: 28) received 46 g; and Group 3 (mean age: 65 years; BMI: 35) received 51 g. The iodine delivery rate was adjusted proportionally to body weight.

Exclusion criteria included cardiomyopathies and significant motion or beam-hardening artifacts. Spectral images acquired during the first-pass end-diastolic phase of CCTA were used to assess absolute myocardial mass and myocardial iodine concentration. Values were subsequently normalized to body surface area (BSA). As expected, absolute myocardial mass and myocardial iodine concentration differed significantly among the three groups (all  $p < 0.005$ ). However, after normalization to BSA, these differences were no longer statistically significant (all  $p > 0.090$ ).

These findings underscore the importance of patient-specific normalization when assessing myocardial iodine distribution with spectral CCTA. BSA-based normalization minimizes variability across body habitus and may aid in establishing reference values for the assessment myocardial perfusion. Such normalized data could enhance the diagnostic accuracy of CCTA in detecting obstructive CAD, particularly in patients with multivessel disease.

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*Abstract 27*

## **A multidisciplinary approach to powering assistive exoskeletons: from biomechanical measurements to hybrid energy systems**

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**Key-Words:** exoskeleton; requirements; power supply; fuel-cell; battery

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This work investigates the feasibility, advantages and challenges of powering a lower-limb exoskeleton using a hybrid battery/fuel cell system, comparing it to a conventional battery-only solution. Batteries have low energy density and slow recharging, limiting autonomy and continuous use. This is crucial in this study, which focuses on a 6-joint lower-limb exoskeleton for assisting elderly patients with sarcopenia. The first step of this activity, presented in this work, was to calculate the energy and power requirements for the system.

A multidisciplinary methodology was developed to translate mechanical requirements into electrical ones. Mechanical assistance needs were quantified through a method based on torque deficits obtained from Maximum Voluntary Contraction (MVC) measurements using the Biodex system on both healthy and sarcopenic subjects. These results were applied to joint-specific power profiles during a gait cycle, walking being the most representative daily activity (around 90%) and therefore suitable for a preliminary study.

By combining these, the total positive power profile was extracted. The full powertrain was then analyzed to define system architecture design and electrical power requirements. The study of the profile enabled adequate battery selection and C-rate range prediction. Based on this, a battery-only system was modeled in Simulink using an Equivalent Circuit Model with parameter extracted from battery tests. In future work, a fuel cell will be added to supply average power, with the battery covering peaks, simulating different hybridization scenarios.

This study highlights the importance of aligning biomechanical analysis with electrical system design in wearable robotics.

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