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Topic	Study and Analysis of Bio-Compatible Materials for Therapeutic Application(s)
Name of Faculty	Faculty of Engineering and Technology
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Keywords	

Findings

- **Geometric Optimization Significantly Reduces Deployment Errors**
  Optimizing geometric parameters such as strut thickness and fillet radius plays a crucial role in minimizing deployment-related issues like foreshortening and dogboning. The study demonstrates that carefully tuned geometries lead to improved structural conformity and better vessel scaffolding during stent expansion.
- **Strut Thickness–Fillet Radius Synergy is Critical**
  An increase in strut thickness enhances radial strength but simultaneously introduces higher stress concentrations at junctions. Incorporating an appropriate fillet radius mitigates these stresses, ensuring a balance between mechanical robustness and structural integrity.
- **Optimal Design Identified**
  The configuration with 0.1 mm strut thickness and 0.01 mm fillet radius was identified as the most effective design. This combination achieved minimal deformation metrics while maintaining high stress tolerance under physiological loading conditions.
- **WE43 Alloy Outperforms Baseline Materials**
  The WE43 magnesium alloy exhibited superior mechanical performance compared to conventional materials, particularly in reducing foreshortening during deployment. Its enhanced strength-to-weight ratio and biocompatibility make it a promising candidate for next-generation stents.

- **Zn-0.8Li-0.4Mg Shows Better Degradation Compatibility**
  The Zn-0.8Li-0.4Mg alloy demonstrated more controlled and physiologically aligned degradation behavior. This ensures gradual load transfer to the vessel wall, reducing the risk of premature structural failure or long-term complications.
- **Bioresorbable Metals Provide a Viable Alternative to Permanent Stents**
  Bioresorbable metallic stents address key limitations of permanent implants, such as chronic inflammation and long-term thrombosis risks. These materials provide temporary mechanical support and safely degrade after fulfilling their therapeutic role.
- **Finite Element Modeling is Effective for Predicting Stent Behavior**
  Finite element analysis (FEA) proved to be a reliable tool for simulating stent deployment under realistic physiological conditions. It enables detailed evaluation of stress distribution, deformation patterns, and performance metrics without the need for extensive physical prototyping.
- **Sensor-Integrated Stents Enable Real-Time Monitoring**
  The integration of capacitive pressure sensors within the stent structure allows continuous monitoring of in-stent conditions. This capability enables early detection of restenosis, potentially reducing the need for invasive diagnostic procedures.
- **PDMS-Based Sensor Design Provides High Sensitivity and Stability**
  The PDMS-based capacitive sensor demonstrated high sensitivity and linear response to pressure variations. Its biocompatibility and flexibility make it suitable for seamless integration into implantable stent systems.
- **Integrated Design Approach (Geometry + Material + Sensing) is the Future of Stents**
  The study highlights that combining geometric optimization, advanced biomaterials, and embedded sensing leads to highly efficient and intelligent stent systems. This integrated approach paves the way for personalized, adaptive, and next-generation cardiovascular implants.