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Biomechanics

Development of a preclinical porcine model to evaluate hernia mesh migration, folding and dislocation

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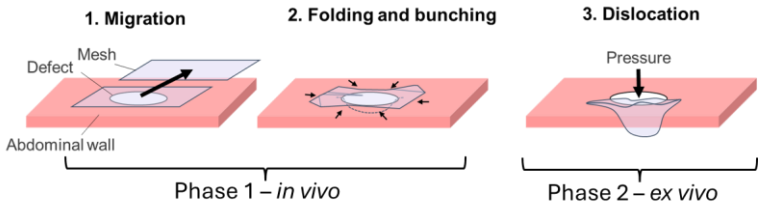
Context

New mesh development

How can we ensure that new implant designs do not promote failure mechanisms?

- Development of a porcine model for the evaluation of mesh performances
- Combination of *in vivo* and *ex vivo* testing - Investigation of 3 failure mechanisms:



Comparison of 3 non-resorbable mesh technologies:

1. Lightweight flatsheet (LWF) - Optilene® Mesh LP - 39 g/m^2
2. Heavyweight flatsheeet (HWF) - Bard® mesh - 99 g/m^2
3. Heavyweight self-fixating mesh (SFM) - ProGrip™ laparoscopic self-fixating mesh - 147 g/m^2

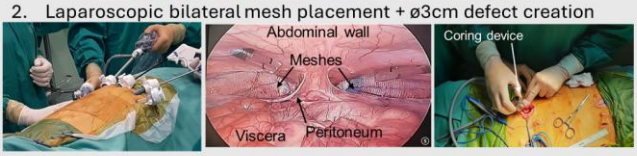
Phase 1: *in vivo* testing

Migration and folding and bunching evaluation, one-week post-surgery

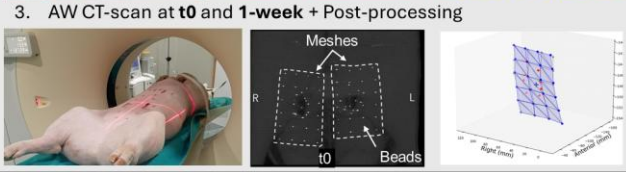
M&M

1. Partially radio-opaque 13x9 cm mesh with micro-beads coating

2. Laparoscopic bilateral mesh placement + ø3cm defect creation

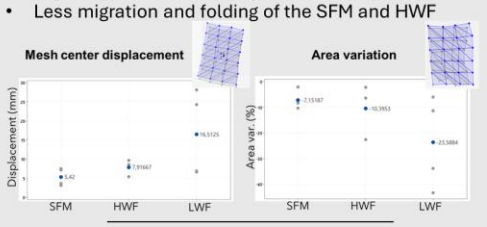


3. AW CT-scan at **t0** and **1-week** + Post-processing

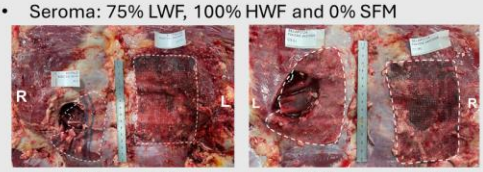


RESULTS - one-week post-surgery - n=4 / mesh type

- High migration and folding and bunching of the LWF
- Less migration and folding of the SFM and HWF



- Mesh dislocation: 100% LWF, 75% HWF and 25% SFM
- Seroma: 75% LWF, 100% HWF and 0% SFM



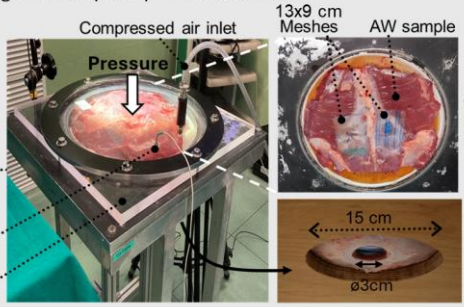
➢ **Reduced risk of migration and bunching with SFM**

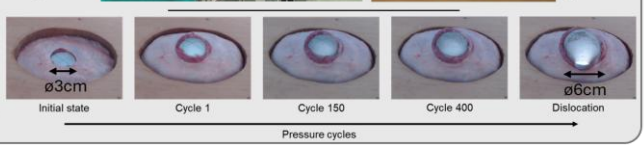
Phase 2 : *ex vivo* testing

Dislocation dynamic bench testing

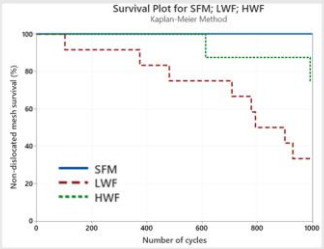
M&M

- Explanted abdominal wall samples
- 250 mmHg cyclic pressure impacts until mesh dislocation[1,2,3]
- Simulating a critical postoperative situation[2]





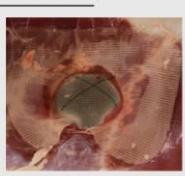
RESULTS



LWF: 66% meshes dislocated (n=8/12) before reaching 1000 cycles
HWF: 25 % meshes dislocated (n=2/8)
SFM: 0 dislocation (n=0/8)

➢ **Ranking was aligned with *in vivo* results**
➢ **SFM provided better protection of the repair**

- **Mechanisms of failure**
  - Mesh creeping[3]
  - Defect opening
  - ➢ Insufficient overlap
  - ➢ Mesh dislocation
- 1 case of LWF mesh rupture



1. A. Végleur et al. 2024 2. C. Lesch et al. 2024 3. F. Kallinowski et al. 2021

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