Study of biomechanical properties of a new nerve guide conduit

M. Swaisi¹,², P. Liverneaux¹,², N. Bahlouli², S. Facca¹,²

¹. Service de Chirurgie de la Main
Hôpitaux Universitaires de Strasbourg

². Laboratoire Icube, UMR 7357, CNRS
Université de Strasbourg
INTRODUCTION

Aims of this study

- Evaluate the biomechanical properties of an innovated Nerve Guide Conduit (NGC)
- Test effects of hydration & different methods of sterilization on physicomechanical properties of NGC
- Compare our results with commercially available NGCs & with rat sciatic nerve
MATERIAL

Fabrication of new NGC

- Biodegradable polymeric materials of PCL
MATERIAL

We tested the effects of

- Hydration

- 2 methods sterilization
  - UV-C light
  - Heat-based hydrogen peroxide
1. Mechanical tensile test
METHODES

2. Flexural bending test

\[ f = -\frac{qL^4}{8EI} \]

Deflection at free end

Section annulaire

\[ I_y = \frac{\pi \cdot (D^4 - d^4)}{64} \]
RESULTS

• Hydration test results

- NGC full Saturated after 15 min

- NGC Saturated 35% after 5 min with no significant changes in geometrical properties (diameter, length) about 2% for our NGC vs 20-30% Neuroflex®
**RESULTS**

- **Hydration test results**

  - Increases stress at break

  - Increases ability of NG to deform before breaking
RESULTS

• Sterilization effects by:
  - UV-C
  - Heat-based hydrogen peroxide

Increase capacity of NGC to deform before failure

Decrease elasticity of NGC became unusefull for bending & clinical operation
RESULTS

• Comparaison with available guides & rat sciatic nerves

Our new performed NGC (dry or hydrated) have Young’s modulus almost closer to that of the rats sciatic nerve
CONCLUSION

- **New PCL NGC**
  - Mechanical properties closed to that of rat sciatic nerves
  - Geometrical properties (length and diameter) after 5 min of hydration are very stables

- **Hydration** improves the mechanical properties of our NGC

- **Sterilization**
  - Heat-based hydrogen peroxide cannot be used
  - UV-C light softening NGC can be used at laboratory level
  - For clinical use, we have to test other technics of sterilization (gamma irradiation, ethylene oxide....)
Take home message!

NGC is a medical device which should be:

• Sterilized & Hydrated before implantation

• Using adequate method of sterilization to conserve biomechanical properties
Thank you for your attention!