Electrospinning and Metal Stents – A Good Fit?

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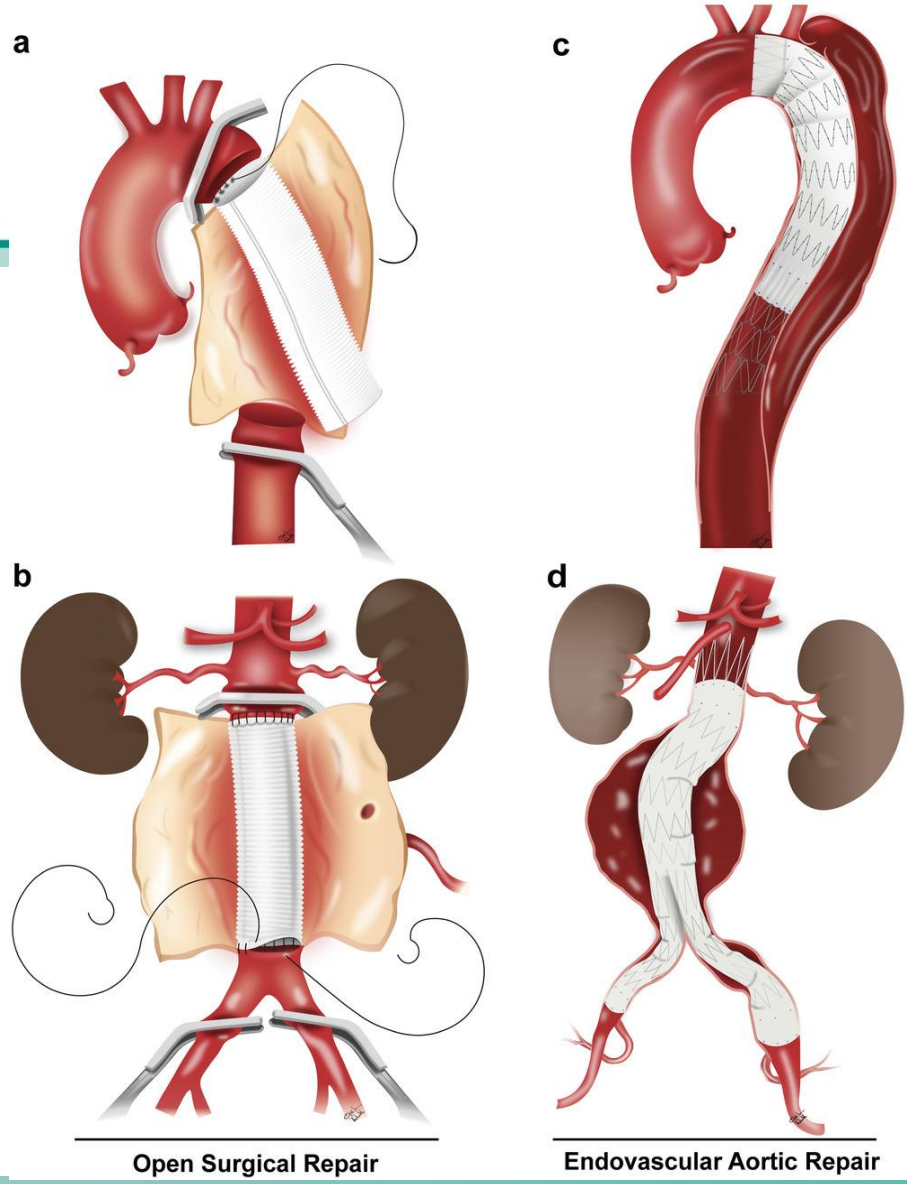
State-of-the-art

- Minimally invasive procedure
- Complete coverage of tears and fewer endoleaks
- Success rates favorable to open surgery



Vahabli *et al.*, Adv. Healthcare Mater. (2022)

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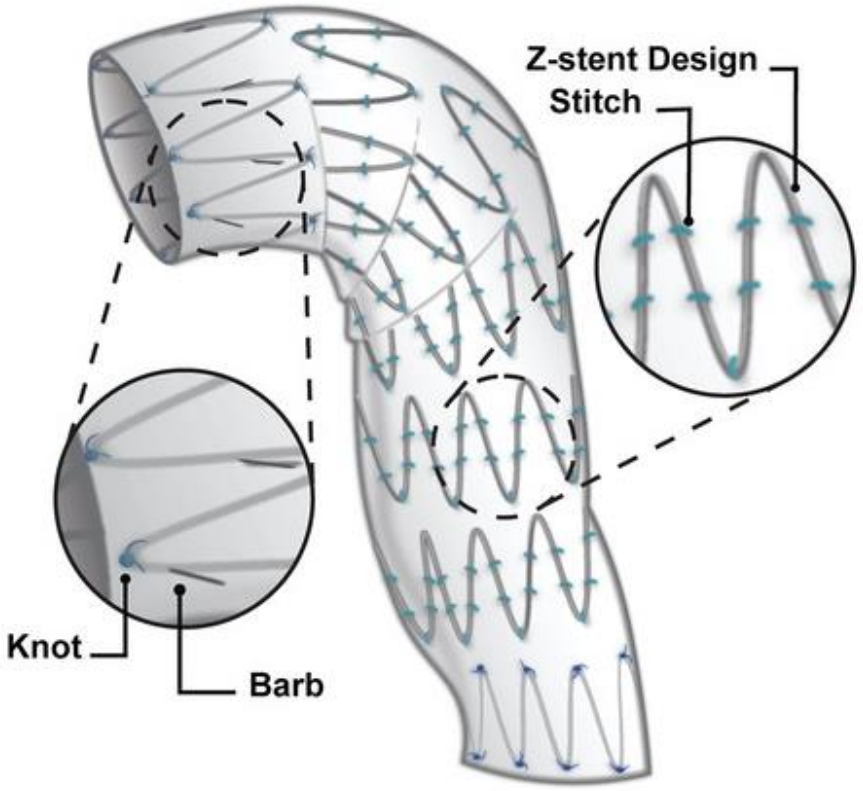
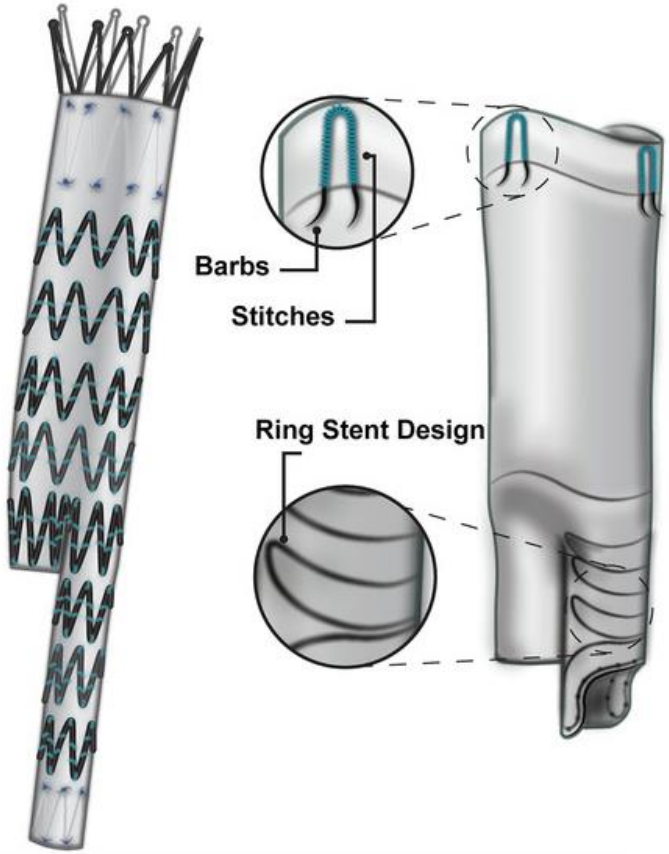
Current commercial products



- Issues:
  - Stiff materials
  - Stitches

- It is vital that the textile matches the mechanical properties of the native aorta as much as possible



Vahabli *et al.*, Adv. Healthcare Mater. (2022)

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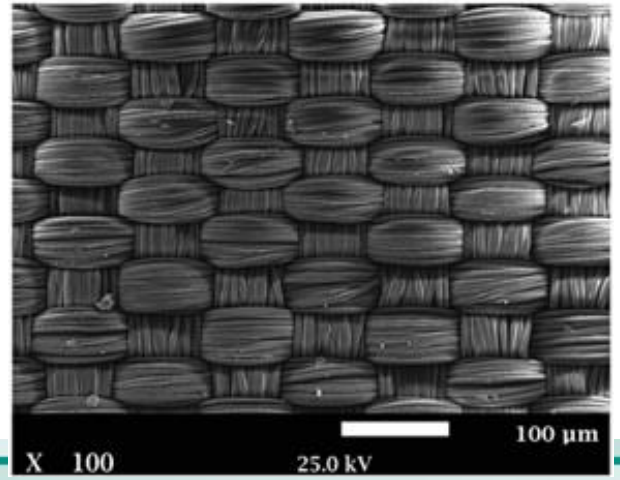
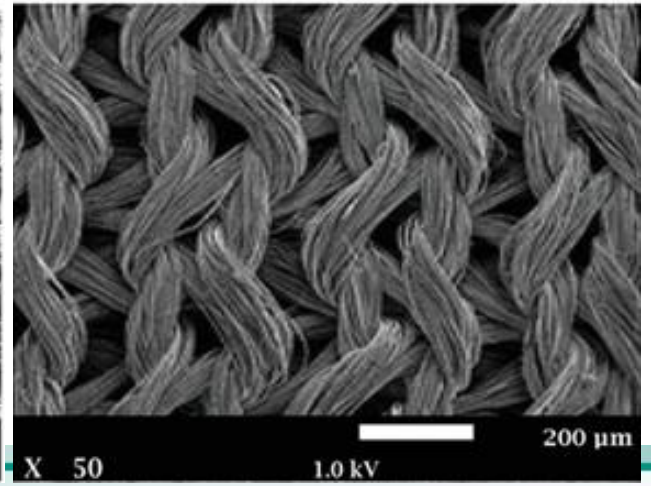
State-of-the-art textiles

Polyethylene terephthalate (PET) – Dacron

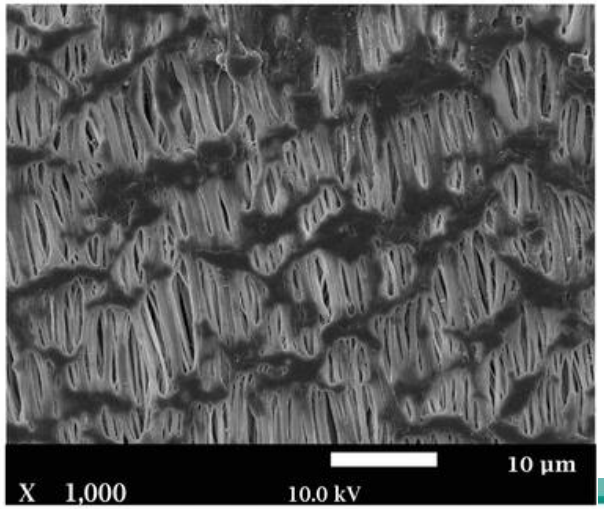
- Weaving and knitting
- Non-reactive
- Different weave designs





Polytetrafluoroethylene (PTFE) – Teflon

- Porous morphology
- Solid nodes connected by fibrils
- Hydrophobic – prevents blood permeation



Santos *et al.,* Proc. Inst. Mech. Eng., Part L (2012)
Yagi *et al.*, J. Artif. Organs (2011)

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The main problem with textiles made by weaving, knitting or braiding is that their high stiffness does not match the mechanical properties of a healthy aorta.

Emerging textiles

- Polyurethane (PU) - Dyneema Purity® (DSM)
- Self lubricating
- Low friction
- Fewer inflammatory responses
- Promoting better healing

Hansen *et al.* (2014)

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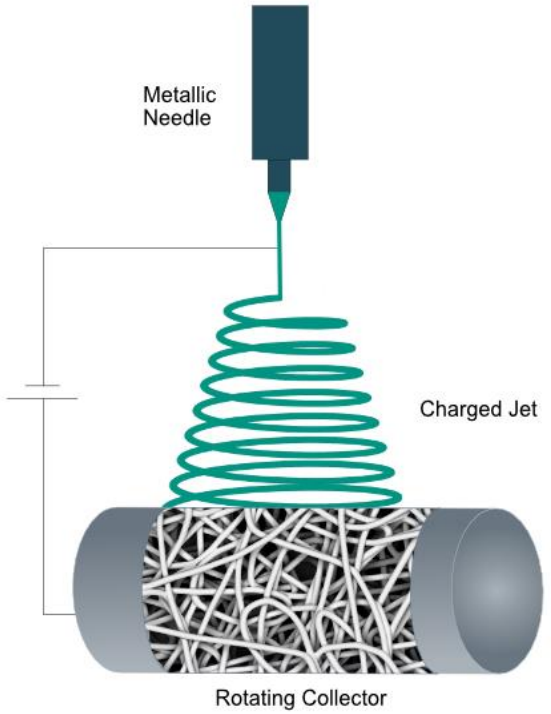
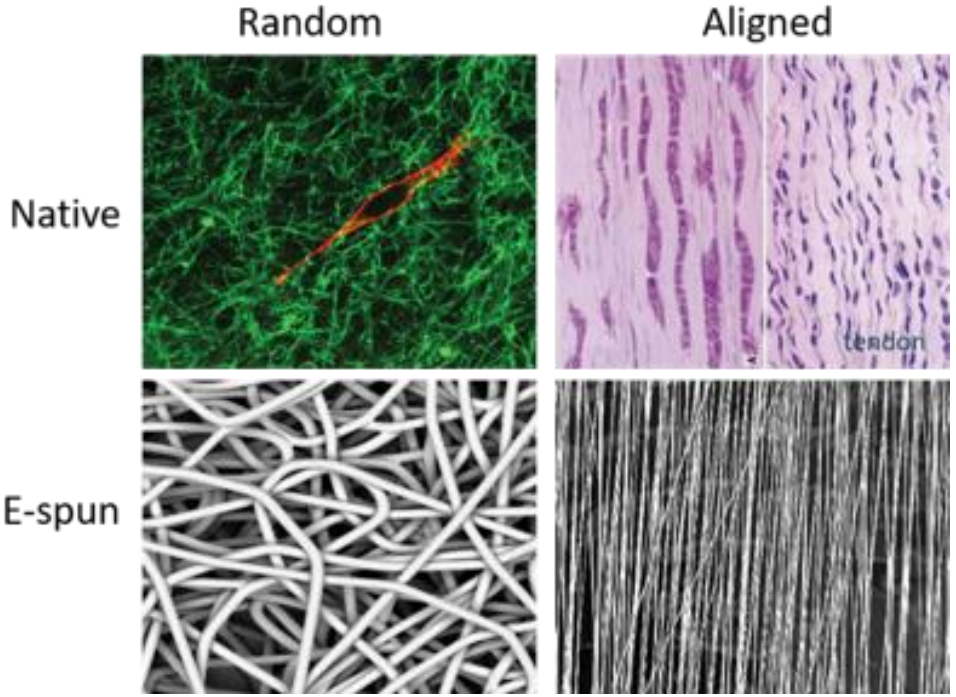
Electrospinning Technology



A medical grade synthetic or natural polymer solution is exposed to an electric field and stretched into thin micro-to submicron fibres

Collected on a drum or 3D shape



Electrospun fibers of aligned or random orientation can mimic the structure of native extracellular matrix

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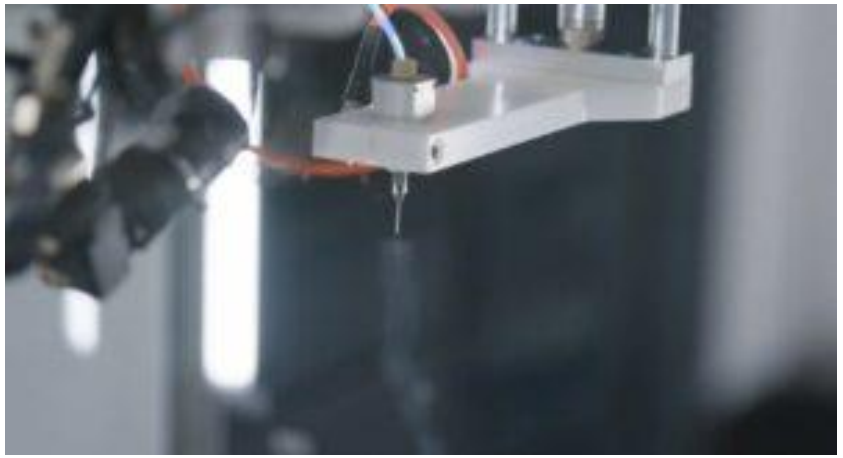
Coverings and Coatings



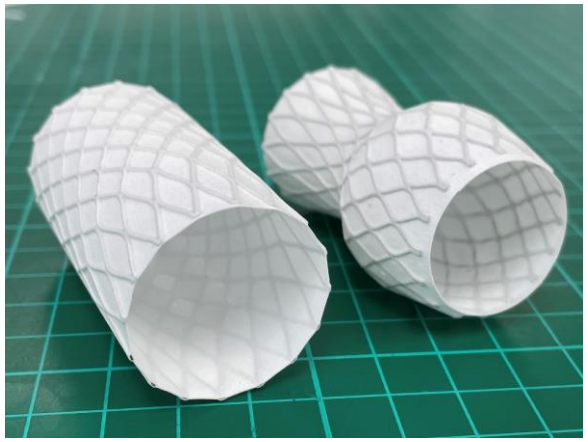
Direct deposition of fibres onto stents or braids

Specialist equipment

Advantages

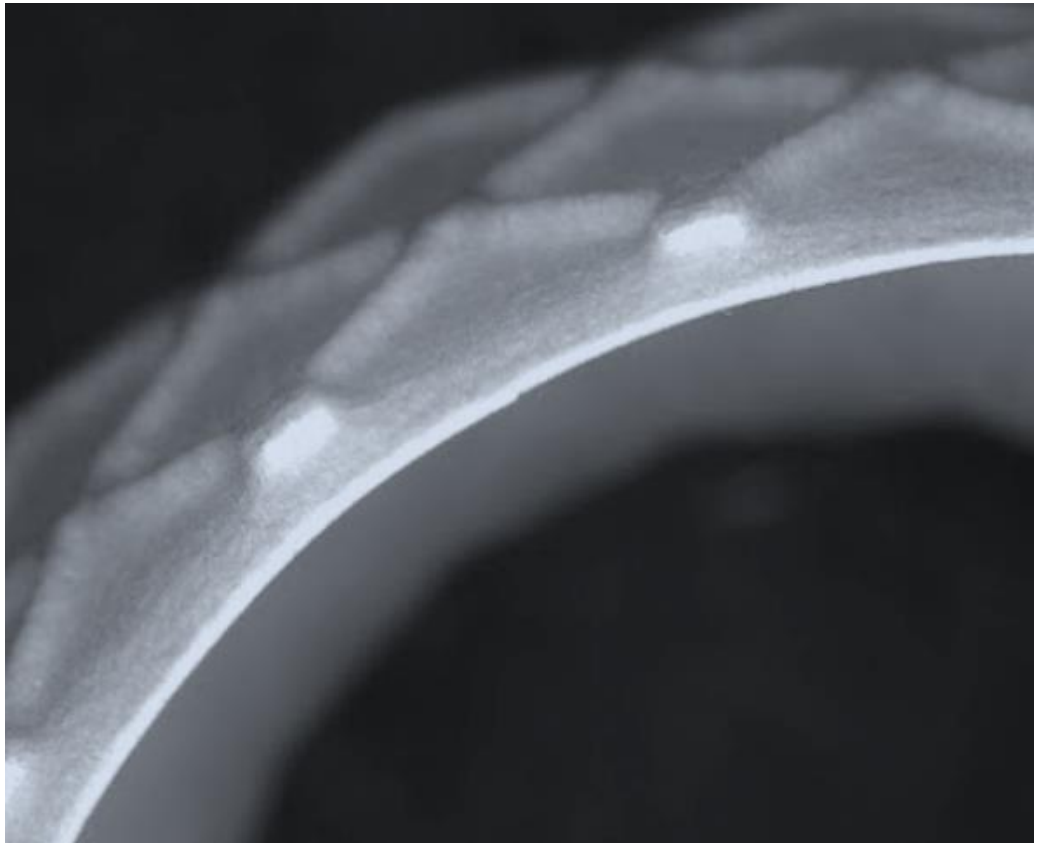
- Wide range of biocompatible materials
- Target material structure and performance to where it is needed
  - Tailorable materials structure
  - Localised/gradient properties
- Eliminate sewing and manual assemblies

Coating Platform

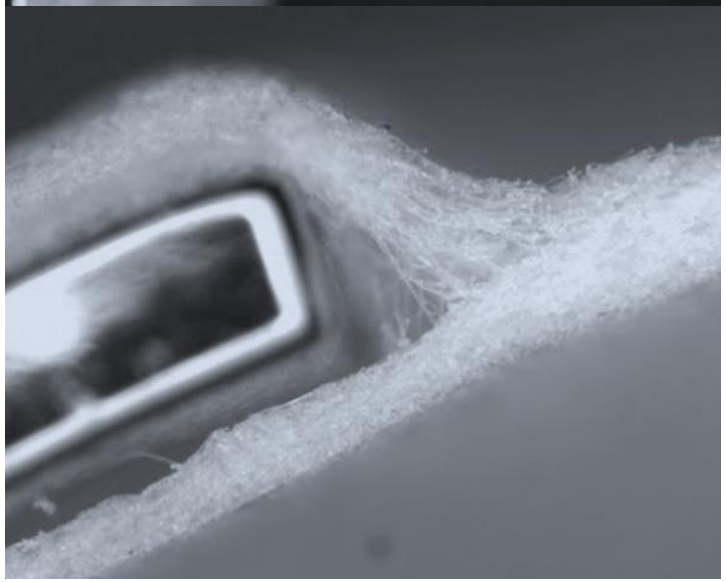


Different geometries

Separate stents



Incorporation inside the fabric



No stitches necessary

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Conclusions

- Endovascular aortic repairs are less invasive
- Current commercial products are expensive and their manufacturing is time consuming
- Electrospinning is an alternative fabrication technique that produces tailorable grafts
  - No stitches
- Clinical and commercial interest is increasing
  - Products in development and testing to ensure robustness for use
  - Patents filed by Edwards Lifesciences Corp and Japan Stent Technology Co

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