An Experimental Evaluation of the Mechanics of Wire-Braided Polymer Bioresorbable Stents

Agnese Lucchetti[1], Thomas Gries[1], Ted J. Vaughan[2]
[1] *Institut für Textiltechnik, RWTH Aachen University, Aachen, Germany*
E-mail: agnese.lucchetti@ita.rwth-aachen.de
[2] *Biomechanics Research Centre (BMEC), School of Engineering, National University of Ireland Galway, Ireland*
E-mail: ted.vaughan@nuigalway.ie

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Introduction: Braided stents are widely used in peripheral intervention thanks to their superior flexibility and major conformability to the anatomic shape of the lesion compared to laser cut devices. Bioresorbable stents have the potential to overcome the drawbacks that are still associated with permanent metallic devices, as they may avoid late-stage issues still associated with the latter. This study systematically investigates the influence of the most relevant braiding parameters on the mechanical properties of the newly developed bioresorbable braided stents.
Materials and Methods: A total of sixteen poly-L-lactic acid (PLLA) stent configurations were manufactured in-house using a horizontal braiding machine. The braiding angle (α=45°, 30° and 20°), the filament diameter (d=100 µm and 150 µm), the stent diameter (D=5 mm, 4 mm and 2.5 mm) the number of filaments (n=24 and 48), and the associated braiding patterns (1:1-1 (24), 2:2-1 (48a) and 1:1-2 (48b)), were varied. The influence of each braiding parameter on the radial, longitudinal and bending behaviour of the stents was investigated by means of a radial compression test, a parallel plate test and a three-point bending test, respectively. The radial compression behaviour was also compared to the one of a Nitinol (NiTi) stent [1] with the same geometrical features as the 5/45/100/24 ("D/α/d/n") PLLA stent.
Results and Discussion: The stents having a lower braiding angle, a higher filament diameter or a higher number of filaments not only showed higher mechanical properties for the three test performed, but they also had comparable mechanical properties to the NiTi device [1] (Fig. 1). This study provides a comprehensive overview of the achievable mechanical properties of newly-developed bioresorbable wire braided stents. The results suggest that they could have similar functional performance to existing metallic devices by appropriately tailoring the braided properties.

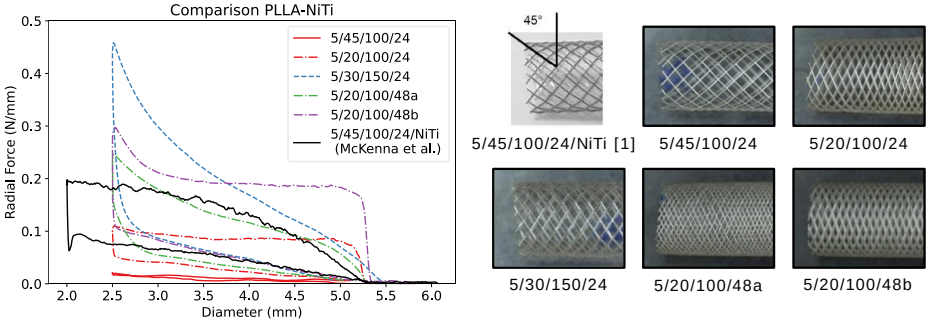

Fig. 1 PLLA vs. NiTi stent radial behaviour (left), and some of the manufactured stents (right)

References

[1] McKenna & Vaughan, Journal of the mechanical behavior of biomedical materials. Volume 103 (2020).