UNIVERSITY OF EXETER

Laser sintered PEEK intervertebral lumbar cages: process and properties

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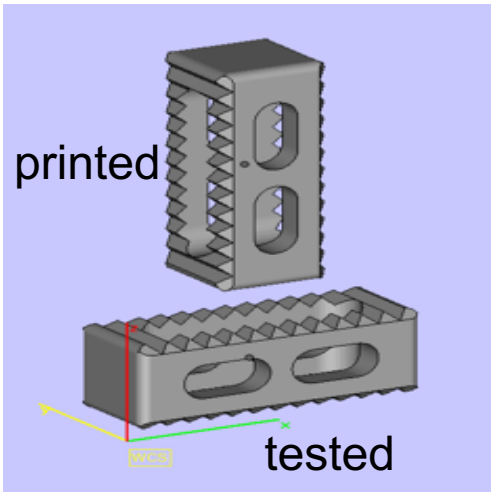
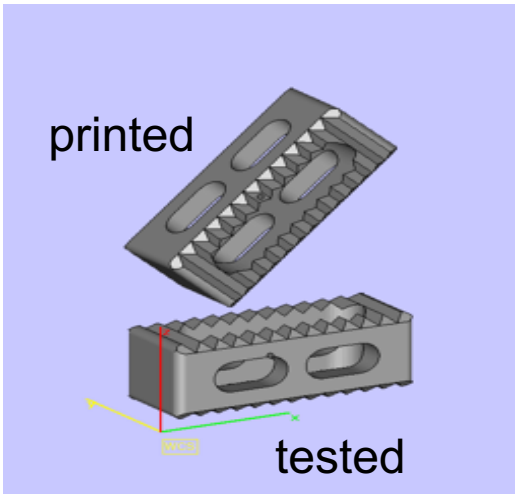
Content

- Experimental design – spinal cages
- Results and discussion
- Conclusions

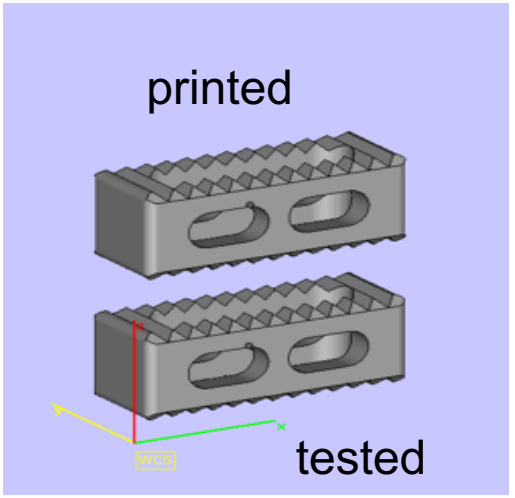
Spinal cages - Printing orientation



VERTICAL



OBLIQUE



HORIZONTAL

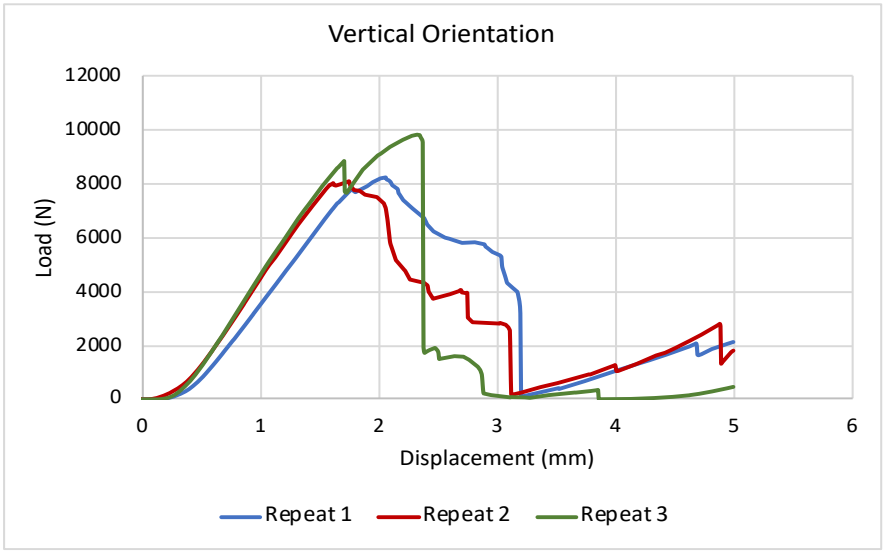
Material: Victrex 450PF PEEK – non laser sintering powder

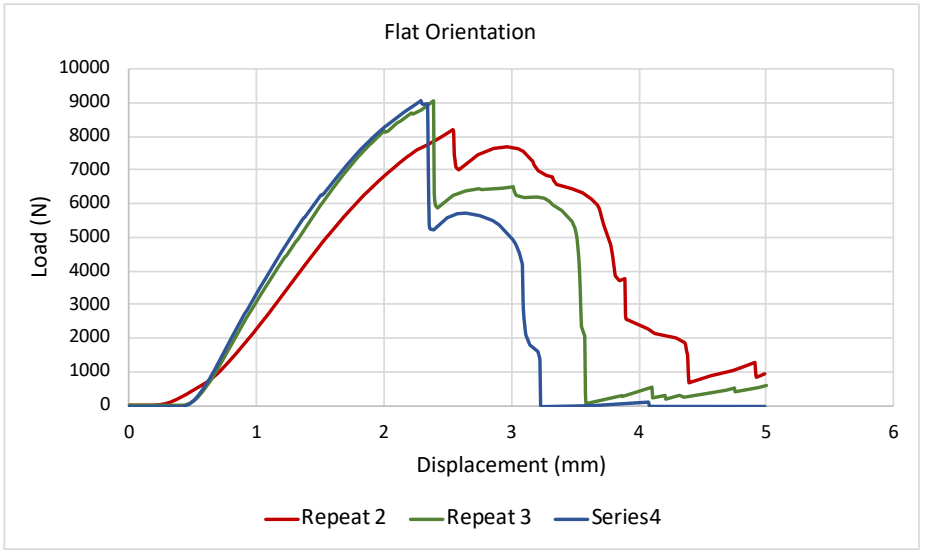
Equipment: Powder bed system EOSINT P800

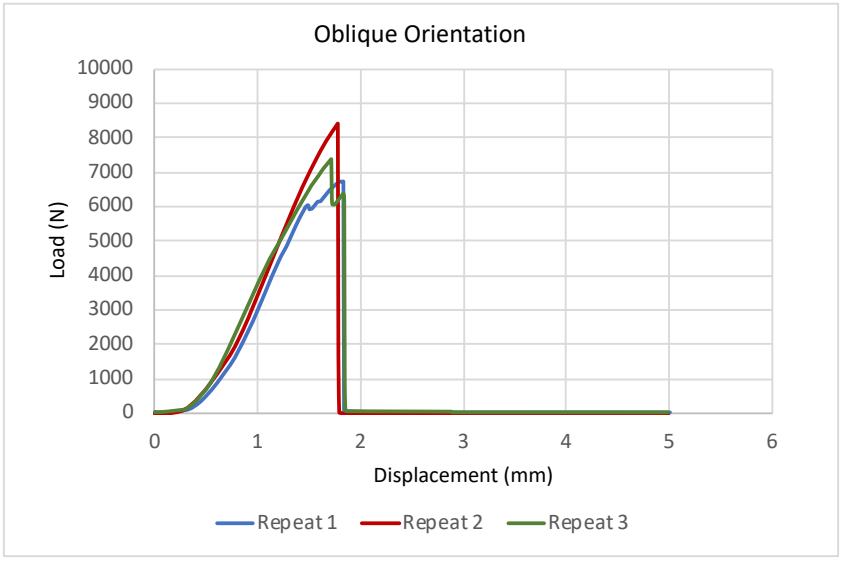
Laser sintering parameters: laser power of 15W, laser speed for 2550 mm s^{-1} , scan spacing, 0.2mm

10 parts tested per orientation

Load – displacement





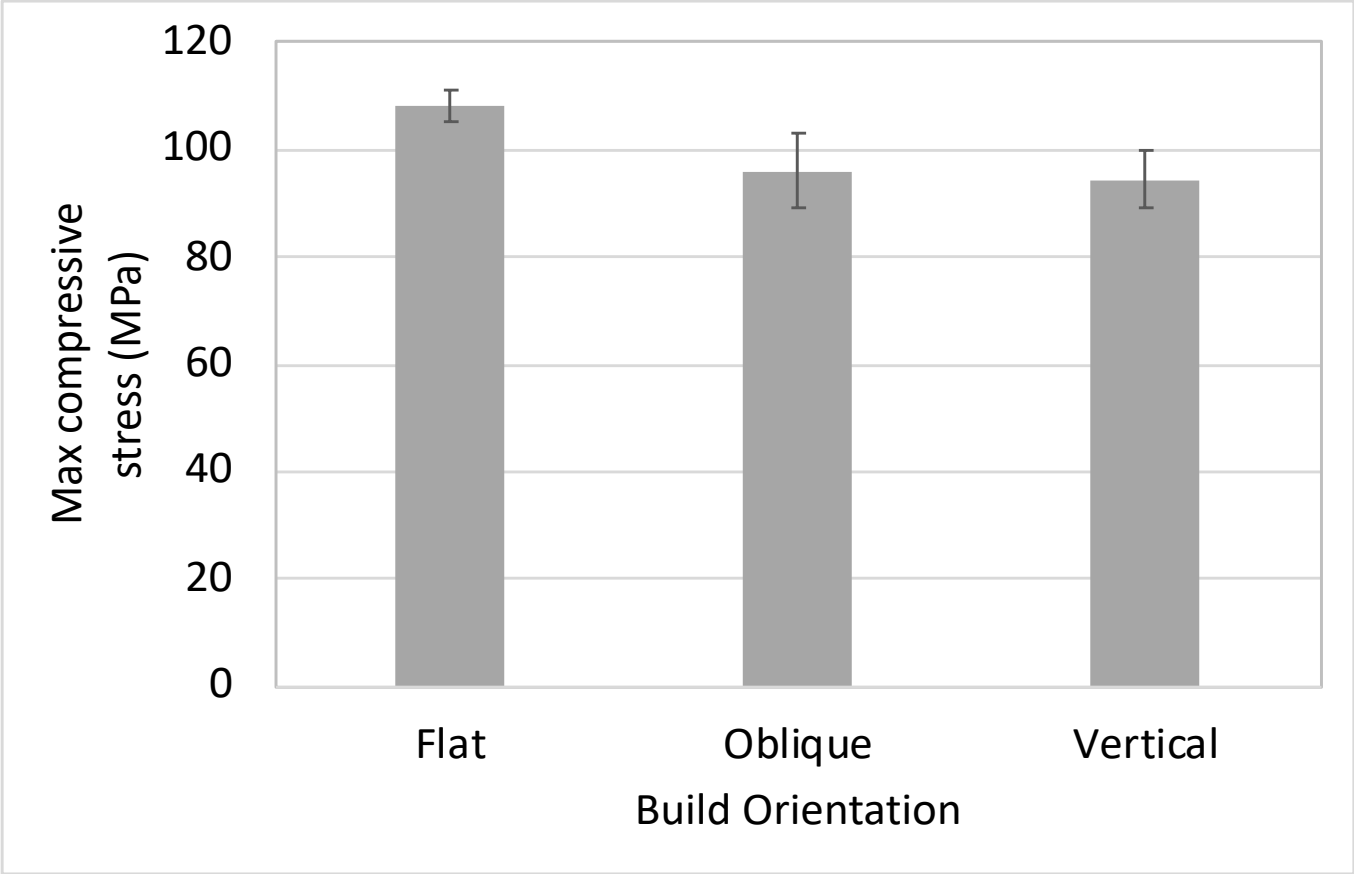


Load – displacement

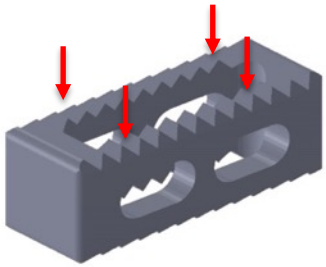
	Max load (N)	Max displacement (mm)	Absorbed Energy (J)
Machined *	14229 ± 335	3.12 ± 0.4	-
FFF *	8964 ± 304	1.43 ± 0.2	-
LS Flat	9074 ± 476	3.8 ± 0.6	18752.2 ± 4780
LS Vertical	8738 ± 896	3.2 ± 0.4	14683.8 ± 2481
LS Oblique	8071 ± 1177	2.2 ± 0.4	6973.58 ± 2006

* *C. Basgul et al., Structure–property relationships for 3D-printed PEEK intervertebral lumbar cages produced using fused filament fabrication, J. Mater. Res., 2018, vol. 33 (14)*

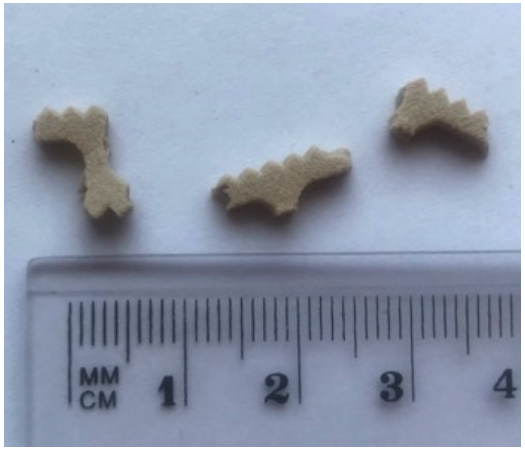
Compressive Strength



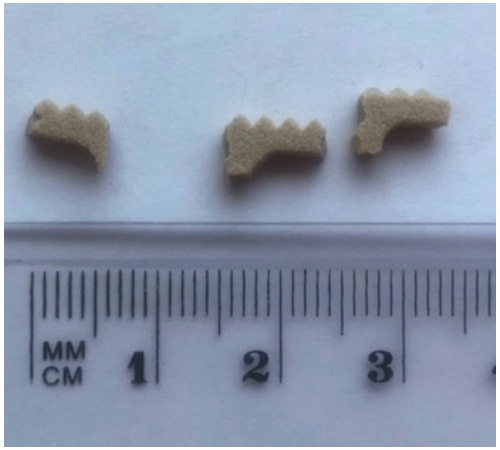
Parts failure



VERTICAL

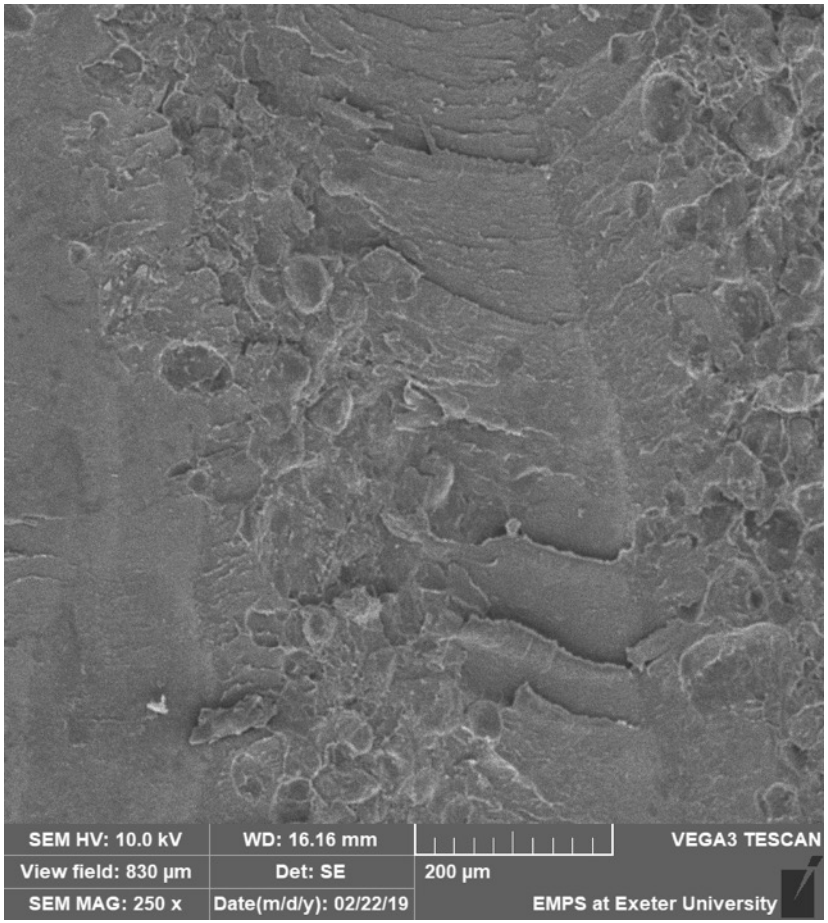


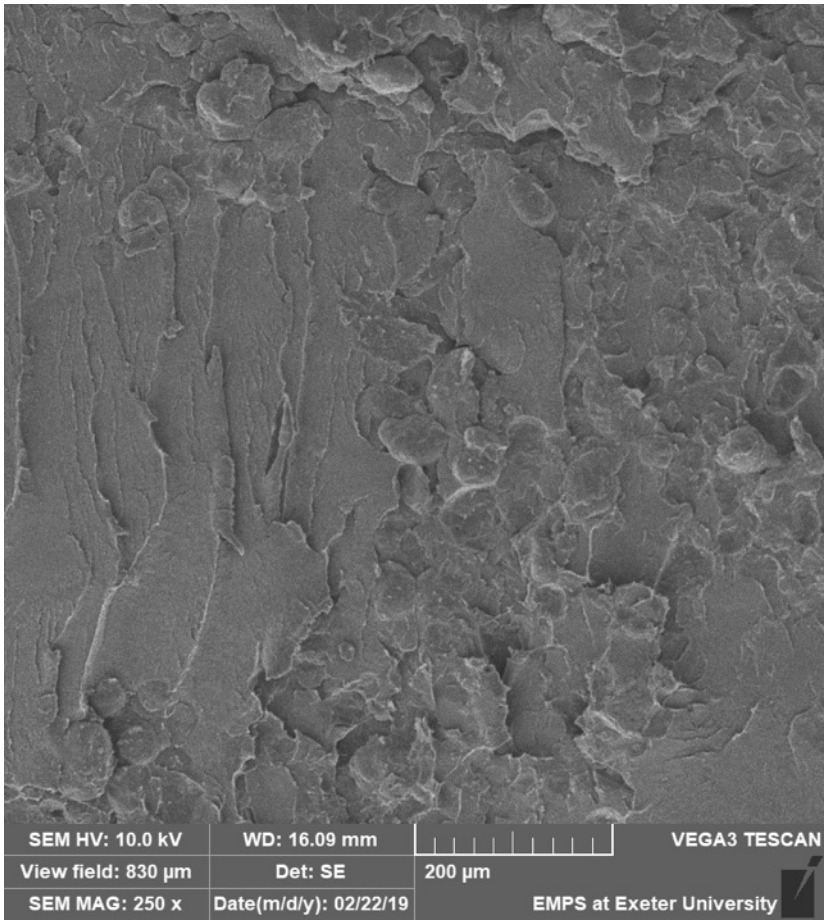
OBLIQUE



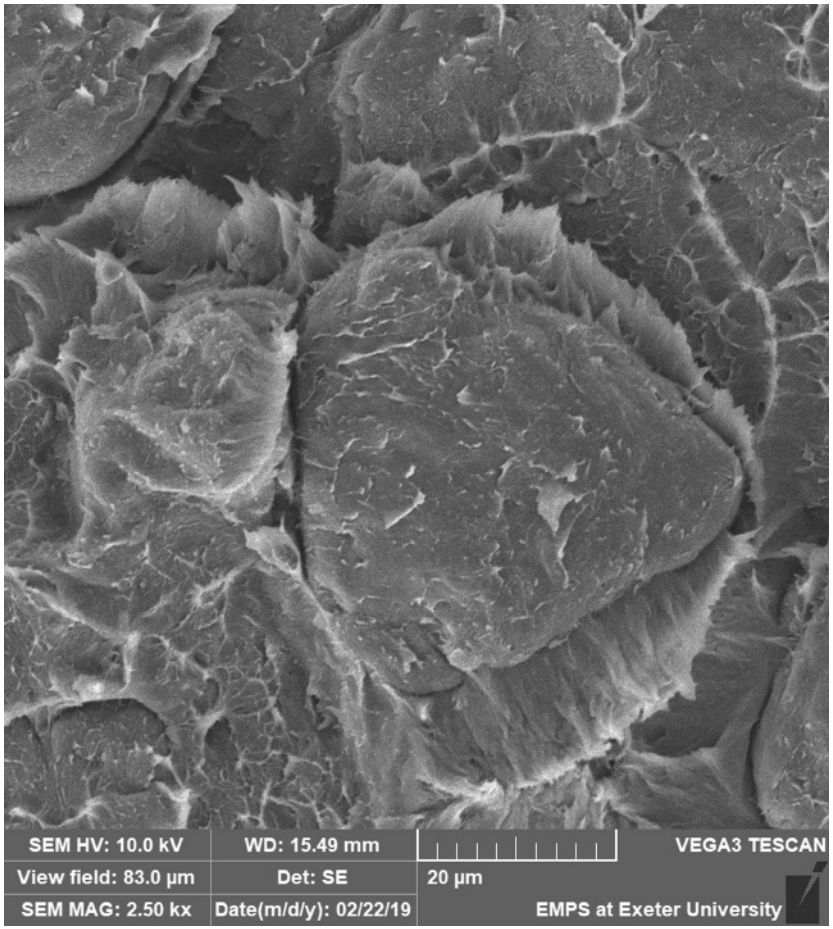
FLAT

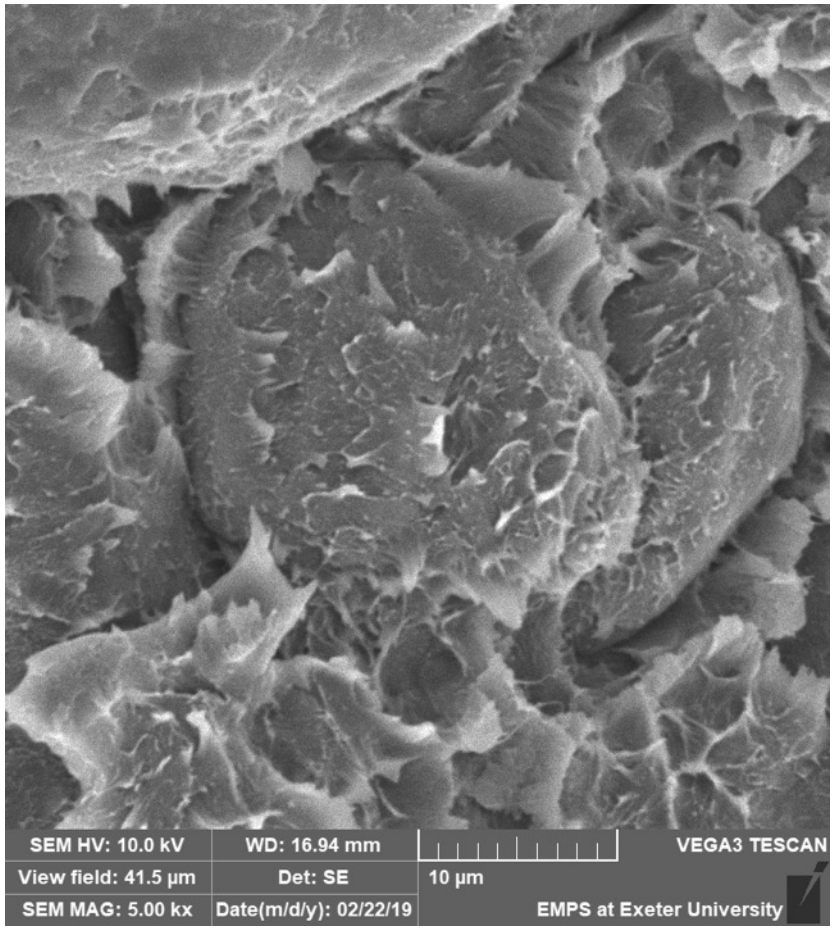
Fracture surface – vertically printed



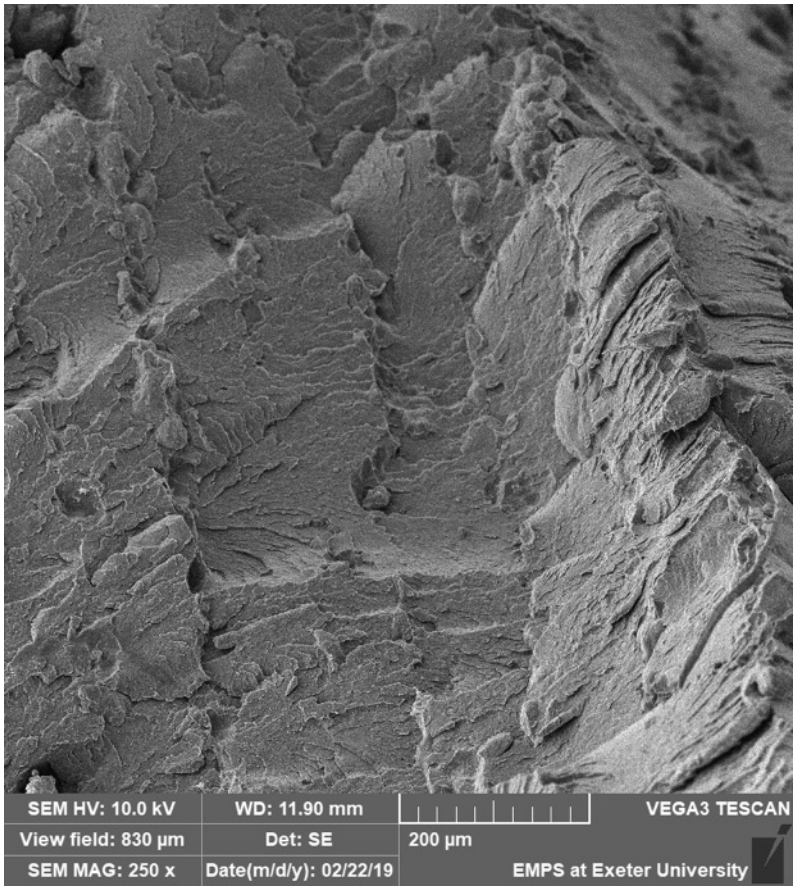


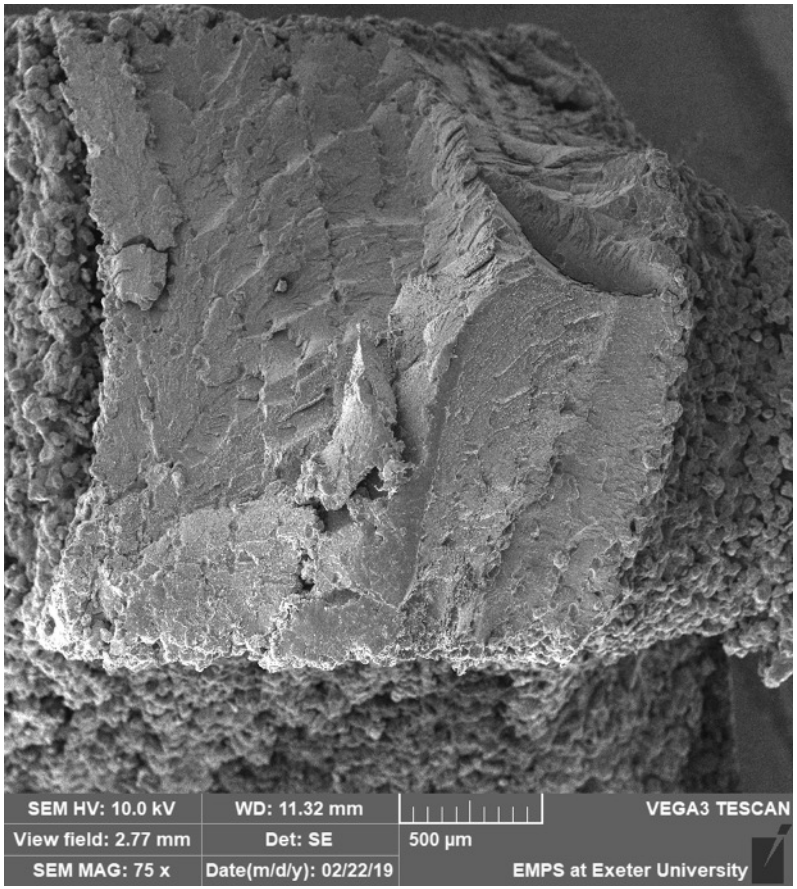
Fracture surface – vertically printed



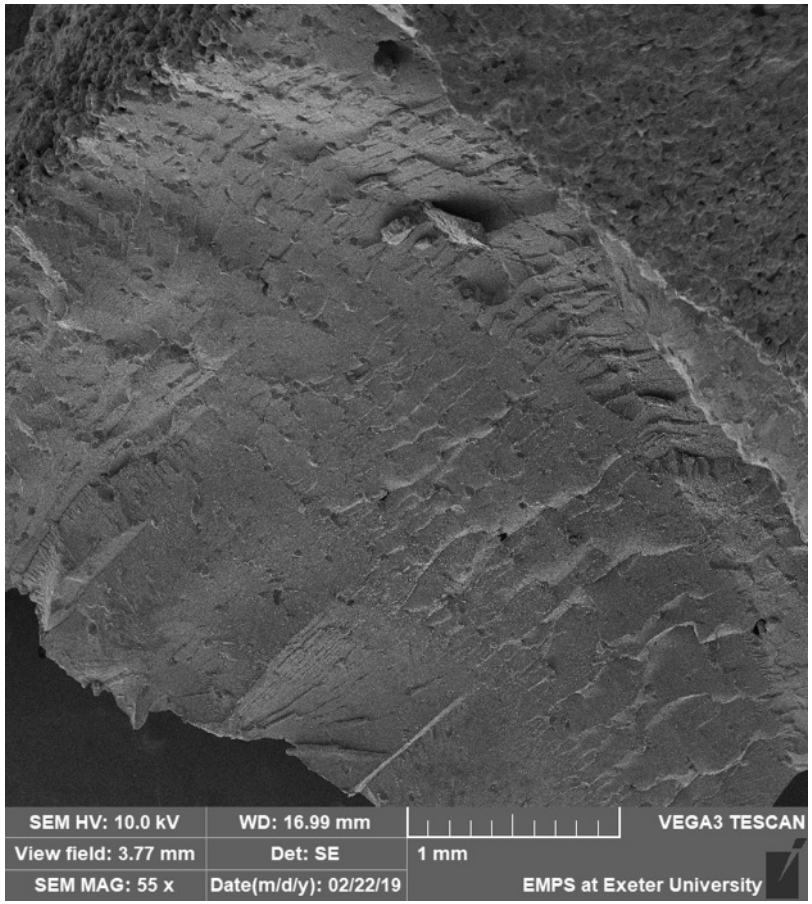


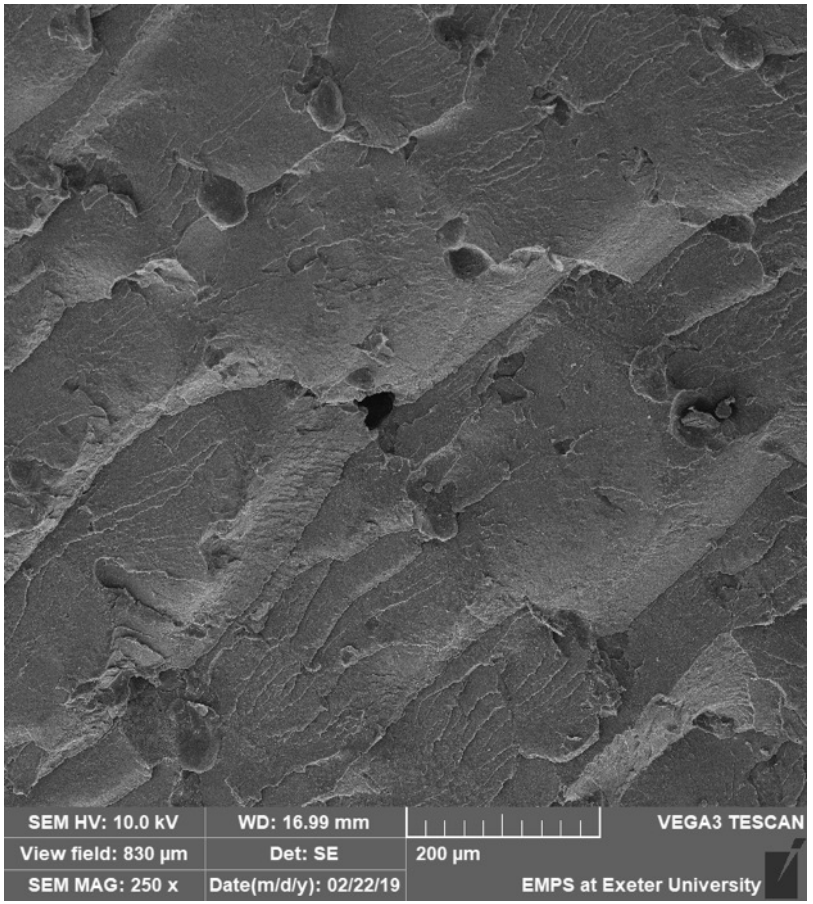
Fracture surface – flat printed





Fracture surface – oblique printed





Conclusions

- ❑ Samples printed flat had the highest compression strength and absorbed most energy during compression testing
- ❑ Sample printed oblique had the worst performance
- ❑ Samples printed vertical had significantly better performance than expected

(HP3 PEK tensile test X/84 MPa $\pm$ 3.6; Y/79 MPa $\pm$ 5.4; Z/44 MPa $\pm$ 3)*

- ❑ Printing in AM requires redesign of the spinal cages

** Ghita et al., High Temperature Laser Sintering (HT-LS): An investigation into mechanical properties and shrinkage characteristics of Poly (Ether Ketone) (PEK) structures, 2014, Materials and Design, vol.61*

Thank you