

Physical assessment of a 3D printed poly lactic acid dart for wildlife contraceptive delivery

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Introduction: Compared to human contraception and domestic animals wildlife contraception presents a number of significant challenges; e.g. remote delivery and numerous target species (1). Remote ballistics delivery is well established however challenges remain such as biodegradation and reliable field-based performance (2). Biodegradable polyesters can be injection molded containing steroids (3). Layer-by-layer deposition 3D printing may be a suitable alternative to injection molding polyester steroid inserts such as darts.

Results and discussion: Depending on the print orientation each print layer was visible running across the body of the dart (Figure 1B) or along the length of the dart (Figure 1C). Horizontal darts required greater force and strain to break and had a greater Young's modulus (Table 1). When fired into a target at 15 m horizontal darts remained intact whereas vertical darts shattered.

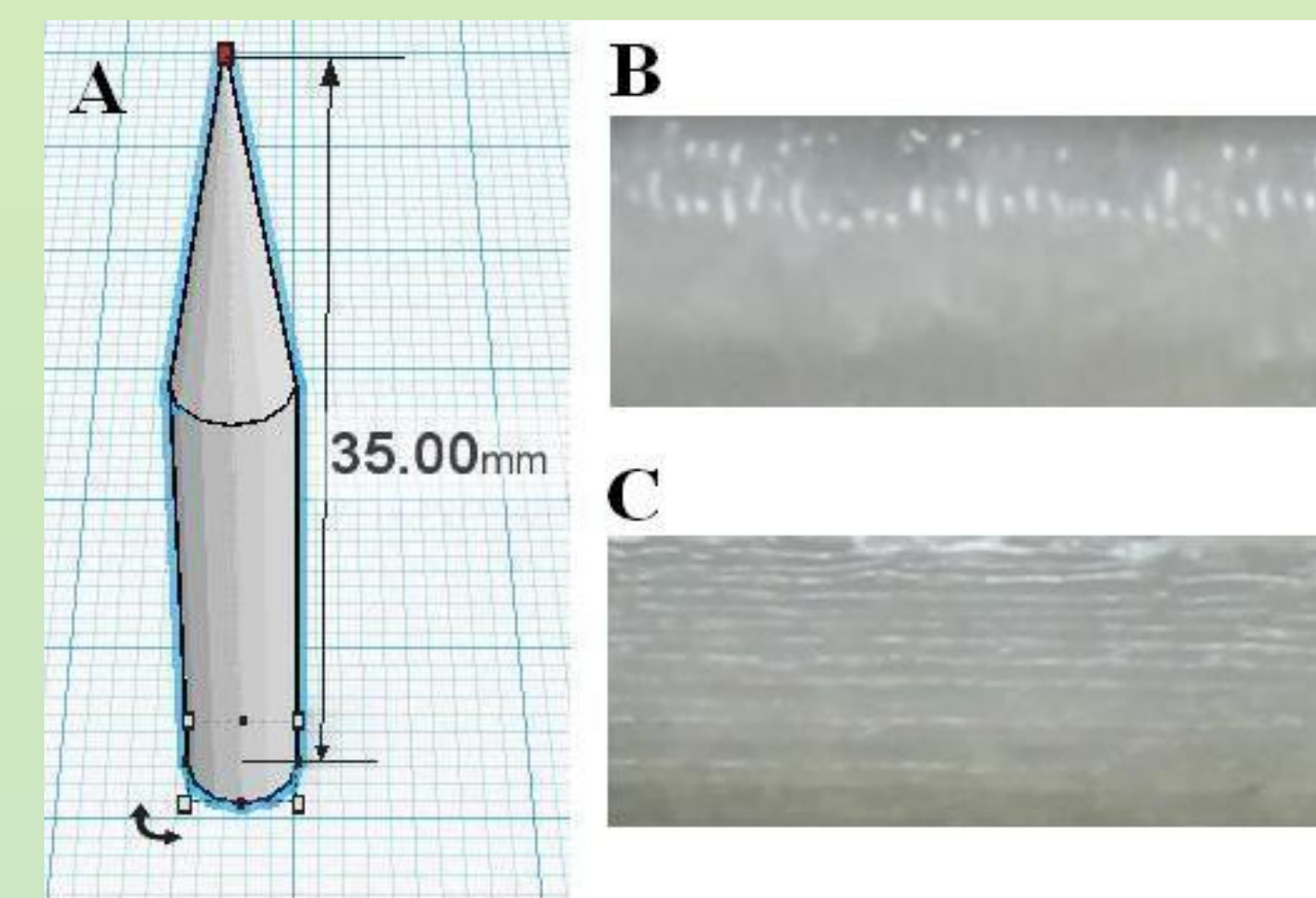


Figure 1. (A) dart design, (B) horizontal print transverse layers, (C) vertical print longitudinal layers.

Table 1. Average (\pm sem) force and strain to break and Young's modulus for darts 3D printed in a vertical or horizontal orientation.

	Vertical	Horizontal
Force (N)	196.7 \pm 10.5	346.5 \pm 2.6
Strain (%)	9.2 \pm 0.3	15.4 \pm 0.5
Young's modulus (MPa)	1.6 \pm 0.1	2.1 \pm 0.1

Conclusions: Print orientation is an important manufacturing parameter and greatly influences the mechanical and ballistics properties of 3D printed darts.

Supplementary results: Progesterone release from a 3D printed poly lactic acid dart containing progesterone 5% w/w was characterized by an immediate without burst and steady release over 24 hours.

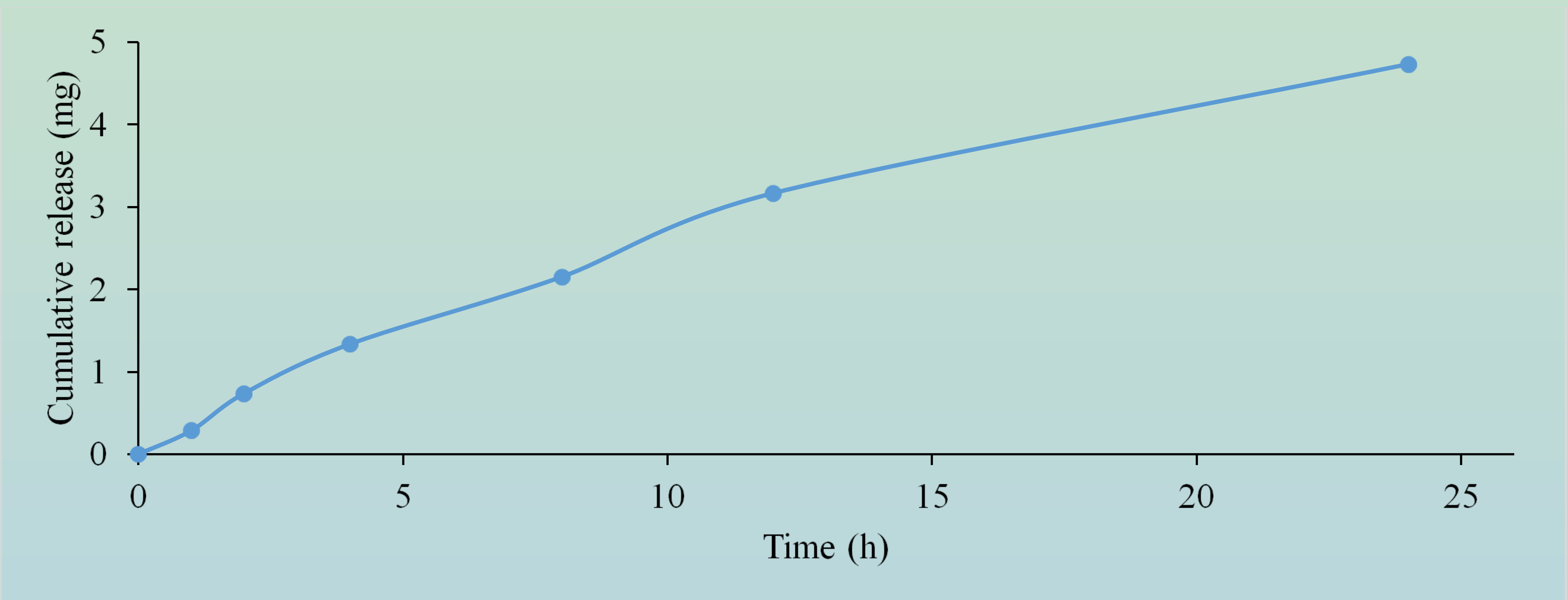


Figure 2. In vitro cumulative progesterone release from the 3D printed dart.

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