In-vitro Cytotoxicity Outcome of 3D Printed Titanium Alloy Parts Manufactured by Selective Laser Melting (SLM) for Potential Orthopaedic Applications

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INTRODUCTION:

Selective laser melting (SLM) is a type of Additive Manufacturing (AM) technology that deposits materials layer by layer towards production of a 3D structure. In orthopaedic field, titanium (Ti) based implants is widely used in orthopaedic surgery due to their excellent properties and biocompatibility. This study aimed to investigate the cell viability after exposed with 3D printed titanium alloy (Ti6Al4V) parts through SLMed technology.

MATERIALS & METHODS:

The ATCC L-929 mouse subcutaneous connective tissue fibroblast cells was used to evaluate the cytotoxicity effect of 100% concentration of Ti6Al4V. Complete growth medium was served as blank control. Negative control was Polyethylene (0.2 g/ml). The positive control was Zinc diethyldithiocarbamate (0.2 g/ml). The Ti6Al4V extraction was tested in triplicate at the 100% concentration. The growth medium from each well of a 24 well plate containing a healthy culture were replaced with 1 ml of the Ti6Al4V extraction, negative control, positive control, and blank control respectively. The cultures then were incubated 37^0C for 24 hours. The healthy cells were counted qualitatively based on grade scores 0-4. Grade 0 considers no reactivity, followed by grade 1(slight), grade 2 (mild), grade 3 (moderate) and grade 4 (severe). The Ti6Al4V extraction will be considered toxic if the achievement of a numerical grade is greater than 2.

RESULT AND DISCUSSION:

Based on Table 1, the MEM elution assay of Ti6Al4V orthopaedic implant extraction demonstrated no reactivity (Grade 0) at the concentration of 100%. The negative, positive and blank controls used in this study responded as expected. The outcome of this study showed that Ti6Al4V orthopaedic implant extraction did not induced cytotoxicity effect even at the highest concentration. In addition, it is demonstrated that Ti6Al4V orthopaedic implant through SLMed technology can be used safely and can be applied in orthopaedic fields for fracture management.

Table 1: Reactivity grades of the Titanium Aluminium Vanadium (Ti6Al4V) orthopaedic implant extract and controls.

			Grade	
	Concentration	Wells	0 Hr	24 Hrs
Titanium Aluminum Vanadium (Ti6Al4V) orthopaedic implant	100 %	A – B – C	0 - 0 - 0	0 - 0 - 0
Blank		A – B – C	0 - 0 - 0	0 - 0 - 0
Negative control		A – B – C	0 - 0 - 0	0 - 0 - 0
Positive control		A – B – C	0 - 0 - 0	4 - 4 - 4

CONCLUSION:

The present study revealed that Ti6Al4V orthopaedic implant through SLMed technology did not demonstrate a cytotoxic effect when exposed to the cell. This outcome shows that Ti6Al4V orthopaedic implant through SLMed technology is biocompatible and shows as potential candidate as implantation for fracture management treatment in future.

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