Assessing the biocompatibility of polyhydroxybutyrate scaffolds for dental stem cell applications

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INTRODUCTION: Polyhydroxybutyrate (PHB), a promising biopolymer with significant potential in the dental field, is an immunologically compatible substance derived from natural and viable sources. Recognized as lipid acid polymers produced intracellularly by bacteria, PHB holds promise for various dental applications. If combined with dental stem cells (DPSCs), its unique properties could further enhance its suitability for innovative and biocompatible scaffold development.

MATERIALS AND METHODS: The production of PHB fibrillar membranes utilized the electrospinning method [1,2], employing an aluminum foil-covered copper plate as the collector. A solution of PHB at a concentration of 8% (w/v) was prepared by dissolving it in chloroform: 2-fluoroethanol (20:1 v/v) at 60°C using a heated magnetic stirrer. The resulting PHB solution was loaded into a 20 ml syringe connected to a syringe pump, set at a flow rate of 0.3 ml/hour. Electrospinning was performed on a copper plate with the power supply set to 10 kV. The isolation and characterization of dental pulp stem cells (DPSCs) were conducted following previously established protocols [3]. Cytotoxicity testing was carried out using the MTT assay, and cellular adhesion was assessed through immunocytochemical staining with DAPI.

RESULTS AND DISCUSSION: The MTT results demonstrated consistently high cell viability comparable to the control group. This indicates that the PHB membranes did not induce cytotoxic effects on DPSCs over the assessed time points (1, 3 and 7 days). The immunocytochemical images obtained after 1, 3, and 7 days of treatment exhibited robust cellular adhesion. This suggests that the PHB scaffolds provided a conducive environment for DPSC adhesion and growth.

This consistency in cellular response underscores the biocompatibility of the PHB scaffolds. The absence of adverse effects on cell viability and adhesion supports the potential of PHB as a suitable material for dental applications. The positive outcomes of this study suggest that PHB fibrillar membranes hold promise for use in dental applications, particularly in the context of DPSC interactions. Further investigations are warranted to explore the long-term effects, structural integrity, and specific molecular interactions between PHB and dental stem cells. These findings contribute valuable insights to the development of biocompatible materials for dental tissue engineering and regenerative medicine.

CONCLUSIONS: In summary, our study demonstrates the sustained viability, lack of cytotoxic effects, and robust cellular adhesion of dental pulp stem cells on PHB fibrillar membranes, affirming the promising biocompatibility of PHB for dental applications.

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