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Neuromodulation of lower limb motor pathways with trans-spinal direct current stimulation: an overview of current findings

Mariana Pereira, Sofia Rita Fernandes, Pedro Cavaleiro Miranda & Mamede de Carvalho

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Materials and methods: Nanoparticles of fluorescein-labelled chitosan/TPP with and without GRP (NG and NP, respectively) were prepared by ionic gelation [3]. Resulting NP and NG were characterised by dynamic light scattering, transmission electron microscopy (TEM) and flow cytometry. The anti-inflammatory activity of NP and NG was assessed in THP-1 cells differentiated to macrophages. Mac-THP-1 cells were pre-treated with both NP and NG, followed by LPS stimulation. Cell viability was assessed by the MTS cell proliferation assay, and levels of TNFα released to cell culture media were determined by ELISA.
Results: The average size determined for NG was increased relatively to the NP, while flow cytometry and TEM analysis indicate the presence of GRP in NG, suggesting an effective incorporation of human recombinant GRP. Flow cytometry studies confirmed the cellular uptake of nanoparticles by macrophages. The GRP-loaded nanoparticles were able to reduce the production of TNFα in LPS-stimulated macrophages.
Discussion and conclusions: The results confirm that chitosan/TPP nanoparticles are excellent drug delivery vehicles for GRP in macrophages and predict a wider therapeutic application in chronic inflammation-related diseases. GRP-containing nanoparticles will be further used in OA functional assays and the results will bring new knowledge on the role of GRP in the interplay between inflammation and mineralisation events associated with OA.

CONTACT Dina Costa Simes dsimes@ualg.pt

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Neuromodulation of lower limb motor pathways with trans-spinal direct current stimulation: an overview of current findings

Mariana Pereira[a], Sofia Rita Fernandes[a,b], Pedro Cavaleiro Miranda[b] and Mamede de Carvalho[a]

[a]Instituto de Fisiologia, Instituto de Medicina Molecular, Faculdade de Medicina, Universidade de Lisboa, Portugal; [b]Instituto de Biofísica e Engenharia Biomédica, Faculdade de Ciências, Universidade de Lisboa, Portugal

ABSTRACT
Introduction: The spinal cord (SC) is a complex structure containing several neuronal circuits related with motor function of the upper and lower limbs, operating under the influence of higher centres. Central nervous diseases can change the responses of the spinal motor circuits leading to its dysfunction. Over the last decade, there has been a growing interest in the study of trans-spinal direct current stimulation (tsDCS) as a potential therapeutic tool to modulate spinal circuits through the application of electric currents delivered non-invasively [1]. Computational modelling studies are potentially useful to optimise electrodes montage in order to target current delivery to specific spinal region and pathways [2].
The aim of this study is to describe the more effective tsDCS electrode montages to maximise the modulation effects in lower limbs, as derived from a narrative review of the literature.
Materials and methods: A literature narrative review was carried out through Pubmed database and manual search, considering the following selection criteria: research papers published in journals with impact factor in the areas of neuroscience, neurophysiology and biomedical engineering from 2008 to 2018; use of keywords related with the topic (tsDCS, trans-spinal, lumbar, thoracic, spinal cord, motor pathways, computational modelling); written in English. A qualitative analysis was performed over the literature selected considering the following items: electrode montage; tsDCS protocol; methods for assessing motor responses; observed changes; computational results; induced electric field (EF) distribution.
Results: Published studies showed different neuromodulation effects on the motor responses of the lower limb. Whereas some studies reported a reduction of spinal motoneurons excitability using anodal tsDCS, others described higher motor unit recruitment with cathodal stimulation (T10–T12), suggesting modulation of Ia-motoneuron (MN) synapse. Other

authors failed to replicate a modulatory effect applying tsDCS [3]. Modelling studies predicted EF magnitudes sufficient for neuromodulation in the montages previously applied in the spinal segments to be modulated when these are located between the electrodes [2].
Discussion and conclusions: Literature review indicates that experimental findings mainly depend on electrode polarity and position over the SC. tsDCS is a tool amenable to modulate motor circuits excitability in the spinal cord. This intervention can have clinical implications in the treatment of conditions like spasticity. However, future studies should consider EF magnitude and its orientation relative to spinal neurons. We propose that future clinical protocols should be guided by computational modelling to increase the chances of consistent positive results [4].

CONTACT Mariana Pereira mariana.fapereira@gmail.com

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Physically crosslinked polyvinyl alcohol hydrogels as synthetic cartilage materials

S. Schweizer[a], I. Monteiro[b], A.S Oliveira[b,c,d], P. Nolasco[b,d], R. Colaço[c] and A.P Serro[b,d]

[a]Chemical Engineering Department, University of Reutlingen, Reutlingen, Germany; [b]CQE, Instituto Superior Técnico – University of Lisbon, Lisbon, Portugal; [c]IDMEC, Instituto Superior Técnico – University of Lisbon, Lisbon, Portugal; [d]Centro de Investigação Interdisciplinar Egas Moniz (CiiEM), Egas Moniz Cooperativa de Ensino Superior, Caparica, Portugal

ABSTRACT
Introduction: Polyvinyl alcohol (PVA) hydrogels have been considered very promising materials for the replacement of cartilage tissues due to their biocompatibility, chemical resistance, swelling capacity, and tribological behaviour [1,2]. However, their mechanical properties are still far from those of articular cartilage. In the present work, some PVA hydrogels are prepared with different compositions and under different conditions, to obtain materials with superior physical and mechanical properties.
Materials and methods: A 13.5% w/w PVA solution, prepared by dissolving the polymer (Mw 145,000 Da) in pure water for 20 h at 95 °C, was poured into Petri dishes and cooled to room temperature (8 h). Cast-drying (CD) (60 °C, 80% RH, 7 days) method was used to produce CD_{PVA} gels. Some of these were subsequently annealed for 30 min at 100 °C, giving rise to $CD_{PVA+A100}$ samples. The freeze-thawing (FT) procedure (6 cycles of 16 h of freezing at −20 °C and 8 h of thawing at room temperature) was chosen to prepare FT_{PVA} and $FT_{PVA+PAA}$ samples. For the latter case, polyacrylic acid (PAA, MW 100,000 Da) was added to the PVA solution in the ratio of 3:10 (w/w) in relation to the PVA. The materials were characterised in terms of water content, wettability (captive bubble method), microstructure (SEM) and mechanical performance (compression tests).
Results: The CD gels presented lower water content and contact angles, a non-porous microstructure (see Figure 1), and higher rigidity than the FT samples. The annealing procedure slightly affected the studied properties of CD_{PVA}, while the addition of PAA improved the water absorption of FT gels.
Discussion and conclusions: The characteristics of PVA-based hydrogels can be easily tailored by adjusting the production method or combining PVA with other compounds in order to produce materials that best resemble human cartilage, and that can be used as substitutes for joint cartilage tissue.