

# Osteoconductivity of UHMWPE fabric for a cervical artificial intervertebral disc: in vitro analysis

Citation for published version (APA):

Jacobs, C., Cramer, E. E. A., Davison, N., Smelt, H., Hofmann, S., & Ito, K. (2019). Osteoconductivity of UHMWPE fabric for a cervical artificial intervertebral disc : in vitro analysis: experimental set-up. Poster session presented at 28th Annual meeting of the Netherlands Society of Biomaterials and Tissue Engineering (NBTE), Lunteren, Netherlands.

### Document status and date:

Published: 01/01/2019

#### Document Version:

Publisher's PDF, also known as Version of Record (includes final page, issue and volume numbers)

## Please check the document version of this publication:

- A submitted manuscript is the version of the article upon submission and before peer-review. There can be important differences between the submitted version and the official published version of record. People interested in the research are advised to contact the author for the final version of the publication, or visit the DOI to the publisher's website.
- The final author version and the galley proof are versions of the publication after peer review.
- The final published version features the final layout of the paper including the volume, issue and page numbers.

Link to publication

## General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- · Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
  You may freely distribute the URL identifying the publication in the public portal.

If the publication is distributed under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license above, please follow below link for the End User Agreement:

www.tue.nl/taverne

#### Take down policy

If you believe that this document breaches copyright please contact us at:

openaccess@tue.nl

providing details and we will investigate your claim.

Download date: 05. Oct. 2023

## Osteoconductivity of UHMWPE fabric for a cervical artificial intervertebral disc: in vitro analysis Experimental set-up

C.A.M. Jacobs<sup>1</sup>, E.E.A. Cramer<sup>1</sup>, N. Davison<sup>2</sup>, H. Smelt<sup>2</sup>, S. Hofmann<sup>1</sup>, K. Ito<sup>1</sup>
Orthopaedic Biomechanics, Dept. of Biomedical Engineering, Eindhoven University of Technology, Groene Loper 3, 5612 AE, Eindhoven, the Netherlands

<sup>2</sup>DSM Biomedical, Chemelot Brightland Campus, Urmonderbaan 22, 6167 RD Sittard-Geleen, The Netherlands

#### Introduction

Cervical artificial intervertebral discs (AIDs) have been developed as a mobility preserving alternative treatment for disc degeneration. Clinical results of existing AIDs have moderate success rates and several limitations still exist. It is hypothesized that these limitations arise from the unnatural mechanism of current AIDs, and that mimicking the native structure of the intervertebral disc (IVD) would lead to appropriate biomechanical properties and less complications. As a result, a novel biomimetic AID was developed as shown in Fig. 1. The design contains a hydrogel core, representing the swelling nucleus pulposus, an ultra-high-molecular-(UHMWPE) weight-polyethylene fiber mimicking the annulus fibrosis. Although a metal endplates with pins is used to achieve initial stabilization to the vertebrae, direct anchorage or osseous integration

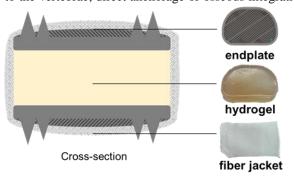


Figure 1: schematic representation of mimetic design.

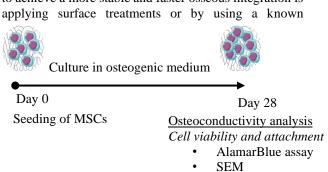
of the UHMWPE fibers to the adjacent bony structures is required to achieve proper biomimetic function. Although it is very strong, the disadvantage of UHMWPE is that it is inert, and therefore does not allow for sufficient osseous integration. A common approach to achieve a more stable and faster osseous integration is applying surface treatments or by using a known

osteoconductive material. Therefore, the aim of this study is to determine the differences in osteoconductivity of different surface treatments of UHMWPE fabrics in comparison with a fabric made from a novel osteoconductive UHMWPE fiber.

## **Experimental set-up**

Six experimental groups (each n=6) will be tested and compared (Fig. 2 right), i.e. 2D knitted fabrics made from: non-treated UHMWPE, osteoconductive UHMWPE, plasma etched UHMWPE, plasma etched osteoconductive UHMWPE, hydroxyapatite (HA) coated UHMWPE; and a pure HA disc (positive control). Plasma etching is known to create a more hydrophilic environment, being favorable for cell attachment. HA is an often-used coating additive because of its biocompatible and osteoconductive properties.

In this research, an osteoconductive material is defined as a material that facilitates bone growth on its surface. New tissue formation on a material is mainly promoted by a surface structure that promotes cell proliferation and production of extracellular matrix. As a result, osteoconductivity will be graded based on three characteristics; cell viability and attachment, osteoblast differentiation and bone matrix production. To assess the differences based on these three characteristics, a static '2D' culture using mesenchymal stromal cells for 28 days will be performed. After 1 and 28 days, cell attachment on the surface will be assessed using scanning electron microscopy (SEM) and cell viability with an AlamarBlue assav. After 28 days, osteoblast differentiation will be verified using alkaline phosphatase activity assay, and staining for osteoblast specific markers osteopontin and osteocalcin. Bone matrix production will be determined with a calcium and collagen I (HYP) assay. A schematic overview of the experimental set-up is shown in Fig. 2.



Osteoblast differentiationALP assayStaining

Bone matrix production

Calcium content Collagen I content

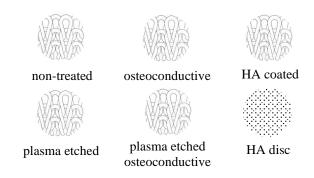


Figure 2: Left: schematic representation of experimental set-up. Right: Experimental groups.