AAO Foundation Award Final Report

Type of Award: Research Aid Award

Name(s) of Principal Investigator(s): Karthikeyan Subramani, Subramanya. N. Pandruvada, David. A. Puleo, James. K. Hartsfield, Jr, Sarandeep. S. Huja

Title of Project: In vitro Evaluation of Osteoblast Responses to Carbon Nanotube-coated Titanium Surfaces

Period of AAOF Support: 07-01-13 to 06-30-15

Amount of Funding: $ 5000

Summary/Abstract:

Background: The effects of surface roughness and carboxyl functionalization of multi-walled carbon nanotubes (MWCNTs) mixed with collagen coated onto titanium (Ti) substrates on MC3T3-E1 osteoblasts were evaluated.

Methods: The proliferation, differentiation, and matrix mineralization were investigated using (1) smooth-surfaced Ti discs, (2) Ti discs coated with collagen and MWCNT (Ti-MWCNT), and (3) Ti discs coated with collagen and MWCNT-COOH (Ti-MWCNT-COOH) for applications in orthodontic mini screw implants (MSIs). The coatings were uniform when analyzed using scanning electron microscopy (SEM), and surface roughness was evaluated by surface profilometry that demonstrated similar surface roughness (R_a, mean ± SD) in the MWCNT (0.83 ± 0.02 μm) and MWCNT-COOH (0.84 ± 0.01 μm) groups. MTT (3-(4,5-dimethylthiazol-2-Yl)-2,5-diphenyltetrazolium bromide) assay was performed after days 1, 3, and 7 to assess proliferation. Alkaline phosphatase (ALP)-specific activity was assessed after day 7 to quantify differentiation. Alizarin red staining was measured after day 28 to quantify matrix mineralization. All data were analyzed with JMP Pro11 software (SAS, USA) with a statistical significance of $p < 0.05$.

Results: Surface profilometry demonstrated similar surface roughness (R_a, mean ± SD) in the MWCNT (0.83 ± 0.02 μm) and MWCNT-COOH (0.84 ± 0.01 μm) groups. On day 7, ALP assay showed that MWCNT-COOH (mean ± SD 0.98 ± 0.26 U/μg of protein) enhanced cell differentiation when compared to the uncoated group ($p = 0.05$). Alizarin red staining after 28 days of cell culture revealed that MWCNT-COOH (mean ± SD 1.5 ± 0.2 OD405) increased ($p = 0.03$) matrix mineralization when compared to the uncoated group (0.9 ± 0.09 OD405).

Conclusions: This study showed that coatings containing MWCNT-COOH (increased hydrophilic surface chemistry) influence osteoblast proliferation, differentiation, and matrix mineralization and should be further studied for applications in orthodontic MSIs.**Response to the following questions:**

1. Were the original, specific aims of the proposal realized?

Yes

2. Were the results published?

Yes. Manuscript was published in "Progress in Orthodontics" journal on 07/27/2016

http://dx.doi.org/10.1186/s40510-016-0136-y

a.) If so, was AAOF support acknowledged.

Yes. The AAOF support was acknowledged in the manuscript

b.) If not, are there plans to publish? If not, why not? ------

3. Have the results of this proposal been presented?

Yes

a.) If so, when and where? And was AAOF support acknowledged.

The work has been presented in

(1) IADR conference March 13, 2015 Boston

Poster # 2576

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(2) E-Poster in AAO 2015 Annual Session. May 15 - 19, 2015. San Francisco.

Abstract # 2093

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The support from the AAOF was acknowledged in both the conferences

b.) If not, are there plans to do so? If not, why not? -----

4. To what extent have you used, or how do you intend to use, AAOF funding to further your career?

I would like to apply for Orthodontic Faculty Development Fellowship award (OFDFA) from the AAOF to pursue my academic research goals.