



CED-IADR/NOF Oral Health Research Congress
Madrid, July 2019

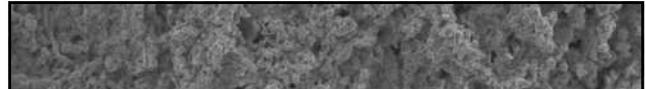
In vitro osteoblast behaviour on machined groove-textured Zirconia surfaces

Joana Marques¹

Mariana Brito da Cruz¹, Joana Marques¹, Beatriz Fernandes¹, Sara Madeira², Óscar Carvalho², António Mata^{1,3}, João Caramés^{3,4}, Filipe Silva²

1- Oral Biology and Biochemistry Research Group, UICDB, Faculty of Dental Medicine, Universidade de Lisboa, Lisboa, 1649-003 Portugal
2- Center for Microelectromechanical Systems (CMEMS), Dept. of Mechanical Engineering, University of Minho, Guimarães, 4800-058, Portugal
3- LIBPhys, Faculty of Dental Medicine, Universidade de Lisboa, Lisboa, 1649-003, Portugal
4- Bone Physiology Research Group, LIBPhys, Faculty of Dental Medicine, Universidade de Lisboa, Lisboa, 1649-003, Portugal

1



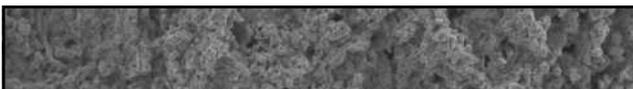
Introduction

- Zirconia (YTZP) is a potential alternative for dental implants
 - favorable esthetic
 - resistance to corrosion
 - bacterial colonization properties



Bauer et al. [J Biomed Mater Res Part B: Appl Biomater](#) 2006
Ciancio et al. [J Biomed Mater Res Part B: Appl Biomater](#) 2017
Schunemann et al. [J Biomed Mater Res Part B: Appl Biomater](#) 2019

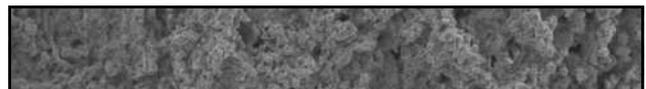
2



Introduction

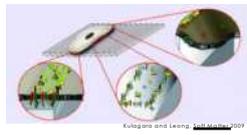
- Need to improve Zirconia **bioactivity** – surface treatments
 - Surface topography and roughness regulate cell morphology and function.
Tanguchi Y, et al. [ACS Biomater Sci Eng](#) 2015
Wimmerberg, A., & Abrahamsen, T. [Acta Biomater](#) 2009
 - Sandblasting and acid etching (SBAE) – lower roughness parameters in Zirconia.
Schunemann et al. [J Biomed Mater Res Part B: Appl Biomater](#) 2019
Ciancio et al. [J Biomed Mater Res Part B: Appl Biomater](#) 2017
 - Alternative strategies for surface functionalization?*

3

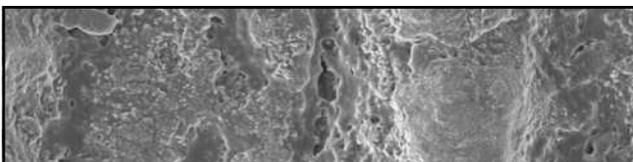


Introduction

- Patterned topography
 - Mimics extracellular matrix structures
Nguyen, T. et al. [ACS Biomater Sci Eng](#) 2014
 - Biomimetic microenvironment for cell culture
 - Groove and pillar textures have been tested with favorable results in other substrates
Tanguchi, Y., et al. [ACS Biomater Sci Eng](#) 2015
Delgado-Rodr. R. A., et al. [ACS Biomater Sci Eng](#) 2014



4

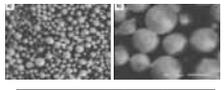
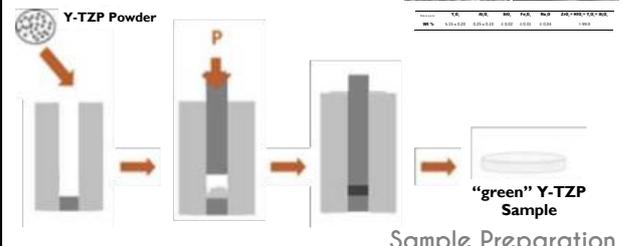


Objective

To evaluate the influence of a grooved-textured Zirconia implant surface in the *in vitro* response of human fetal osteoblasts

5

Materials and Methods

Y-TZP Powder

Sample Preparation

“green” Y-TZP Sample

6

Materials and Methods

Milled grooves
10µm of depth
10µm of width
100µm of spacing

Test: T-YTZP disc Control: S-YTZP disc

Sinterization
SB-AE protocol
Mean surface roughness: $2.25 \pm 0.45\mu\text{m}$

Sample Preparation

7

Materials and Methods

hFOB 1.19 (ATCC® - CR-11372M; American Culture Collection, Manassas, Virginia, EUA)

Cell Viability (Resazurin)	1, 3, 7 and 14 days
Cell Morphology (SEM)	1 day
Collagen type I (ELISA)	3 and 7 days
Osteopontin (ELISA)	3 and 7 days

W1519 group based on 3 independent tests
ANOVA (Tukey's post-hoc)
significance = $p < 0.05$

Cell Culture

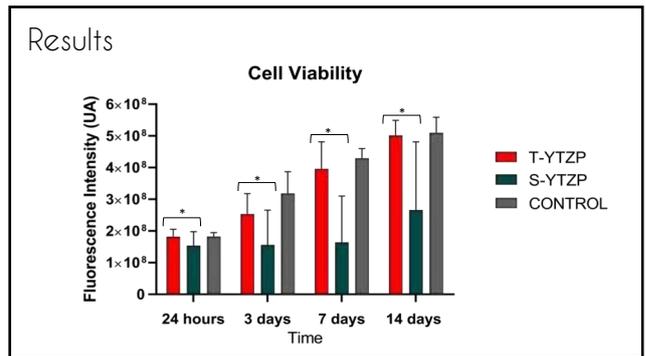
8

T-YTZP S-YTZP

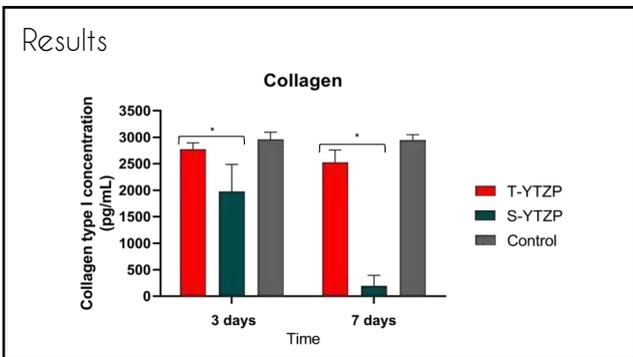
Results SEM

T-YTZP S-YTZP

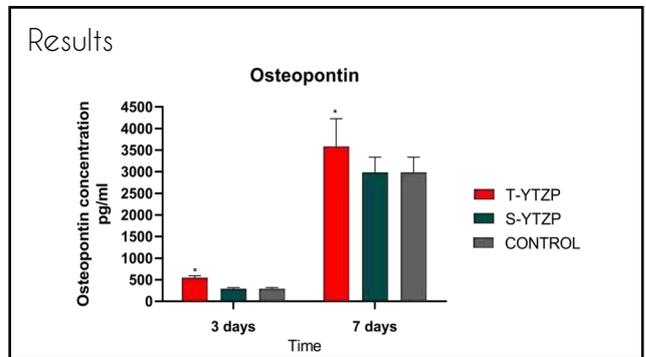
9



10



11



12

Discussion

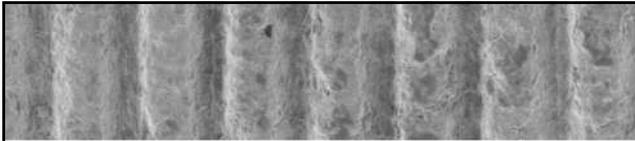
Both T-YTZP and S-YTZP samples were treated by the same protocol (SB-AE), having similar mean surface roughness.

The addition of milled grooves with 100 µm spacing, 90 µm width and 10 µm depth in YTZP surfaces resulted in a significant increase in osteoblast viability and differentiation, suggesting a potential benefit for this type of texture in the biological events of osseointegration.

Differences in the morphology of cells on T-YTZP and S-YTZP are likely to reflect any cytoskeleton organization essential for cell differentiation.

There is the need for more studies to fully understand the role of YTZP surface texturization in the improvement of osteoblast viability, differentiation and bone matrix synthesis.

13



Machined groove-textured YTZP with sandblasting and acid-etching produced an enhanced osteoblast response considering viability, differentiation and bone matrix synthesis, when compared to untextured sandblasted and acid-etched surfaces with similar surface roughness.

Conclusion

14

Acknowledgments



- The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest

This work was supported by the Scientific outreach fellowship from Portuguese Society for Dental Medicine and Stomatology (SPEMD) and by FCT (Science and Technology Foundation - Portugal) under the Funimp project 01-0145-FFDFR-030498. Co-financed by



15



Thank you!



joana.marques@fmd.ul.pt

16