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HARD-TISSUE CELL RESPONSE TO ZIRCONIA IMPLANT SURFACES COATED WITH MTA

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INTRODUCTION

Peri-implantitis

Need for optimization of biological response, inhibition of bacterial adhesion and biofilm formation:

- Prevention of biofilm formation
- Coatings with antibacterial properties
- Optimal biological seal

INTRODUCTION

BIOACTIVE AGENT

MINERAL TRIOXIDE AGGREGATE

- Excellent chemical, physical and biological properties (Perinpanayagam et al. 2009, Ha et al. 2017, Tabari et al. 2020)
- Used in dentistry for over 20 years: endodontics and vital pulp therapy (Main et al. 2004, Karabucak et al. 2005)
- Antibacterial and antifungal properties? (Parirokh et al. 2010, Singh et al. 2016, Jonaidi-Jafari et al. 2016)
- No studies of its use in dental implants (Naik et al. 2014)

A scanning electron micrograph (SEM) showing a highly textured, porous surface. The surface is covered with a dense network of interconnected fibers or filaments, creating a complex, three-dimensional structure. The overall appearance is that of a biological or synthetic scaffold material.

OBJECTIVE

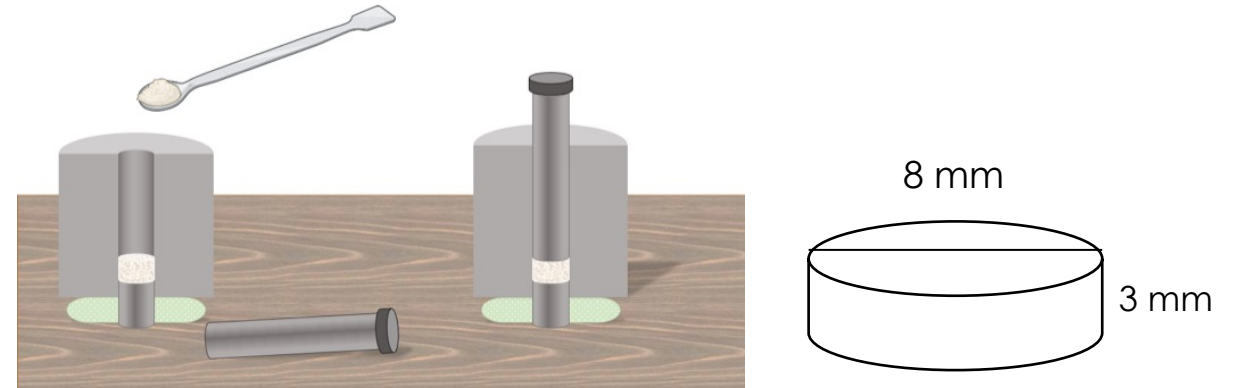
Evaluate the **biological response of human osteoblasts** in contact with zirconia implant surfaces coated with **MTA**

Materials and Methods

Pressing technique

Laser texturing Nd:YAG (OEM Plus, SISMA, Italy)

Wavelength (nm)	1064
Maximum Power(W)	6
Spot size (μm)	30
Pulse width (ns)	35
Repeat Rate (kHz)	20
Focus distance (mm)	328

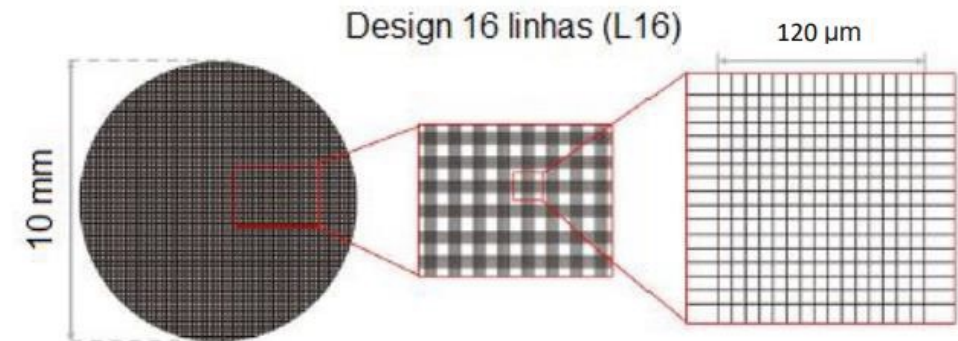


(created with BioRender©)

Sintering and coating with MTA

Sample groups (n=15/ group)

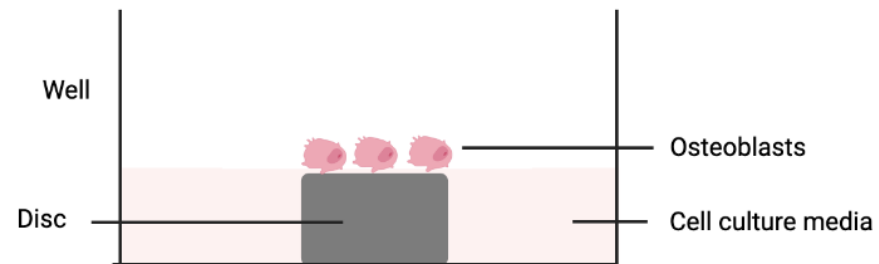
Designation	Description
Zr MTA	MTA-coated laser textured Zirconia samples
Zr Textured	Laser textured Zirconia samples
Zr Untextured	Untextured Zirconia samples
Ti Untextured	Untextured Titanium samples



Sample Preparation

Materials and Methods

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



Assay	Time-points
Cell Adhesion and Morphology (SEM)	1 day
Cell Viability (Resazurin)	1, 3, 7 and 14 days
IL-8 and Osteocalcin (ELISA)	1 and 3 days

Cell Culture

Statistical Analysis

Calculation of Sample size and Statistical power

n=15

(Penārrieta-Juanito GM et al, 2018)

Mean values of Cell viability, IL-8 and Osteocalcin

IBM SPSS® Statistics for Mac version 27.0.1.0

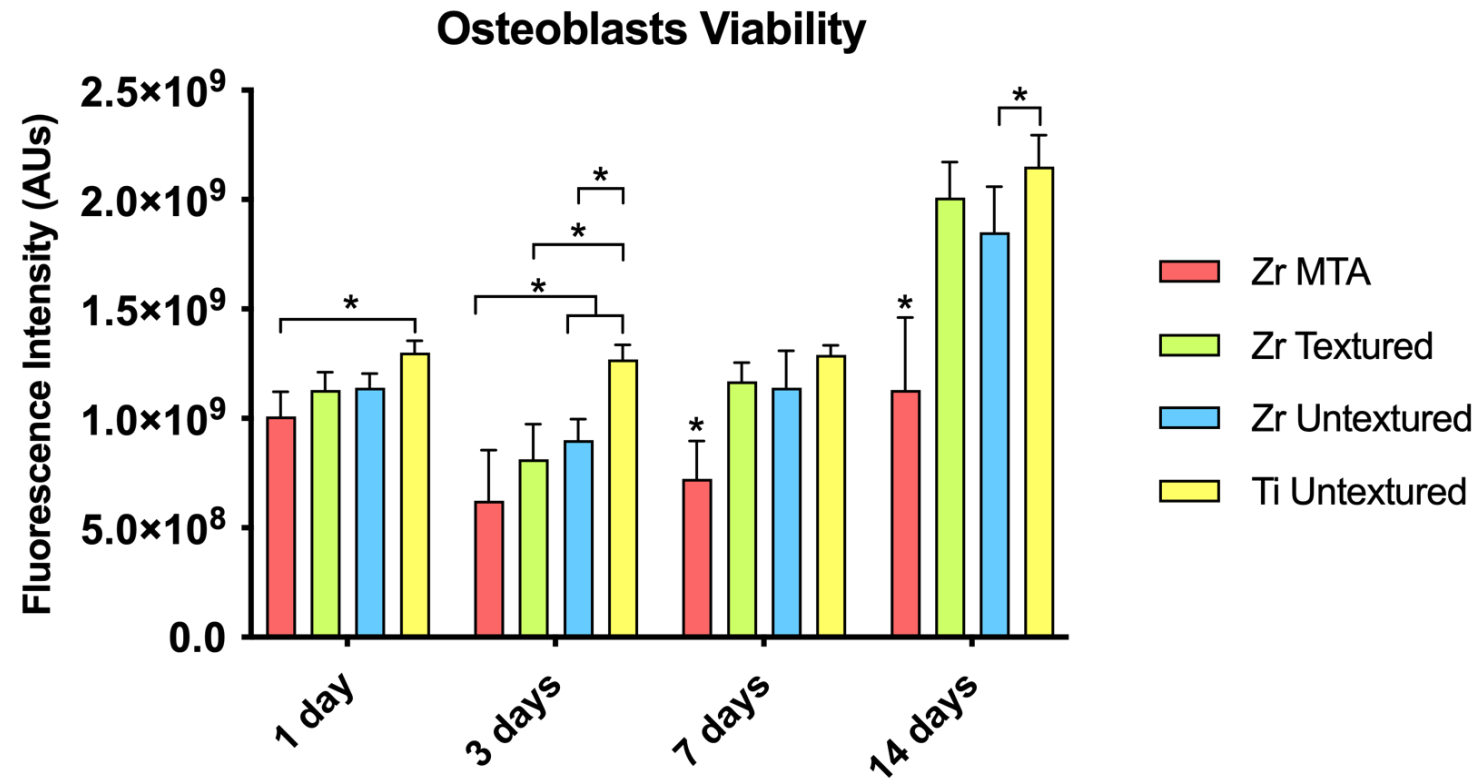
Kolmogorov-Smirnov test: normal distribution

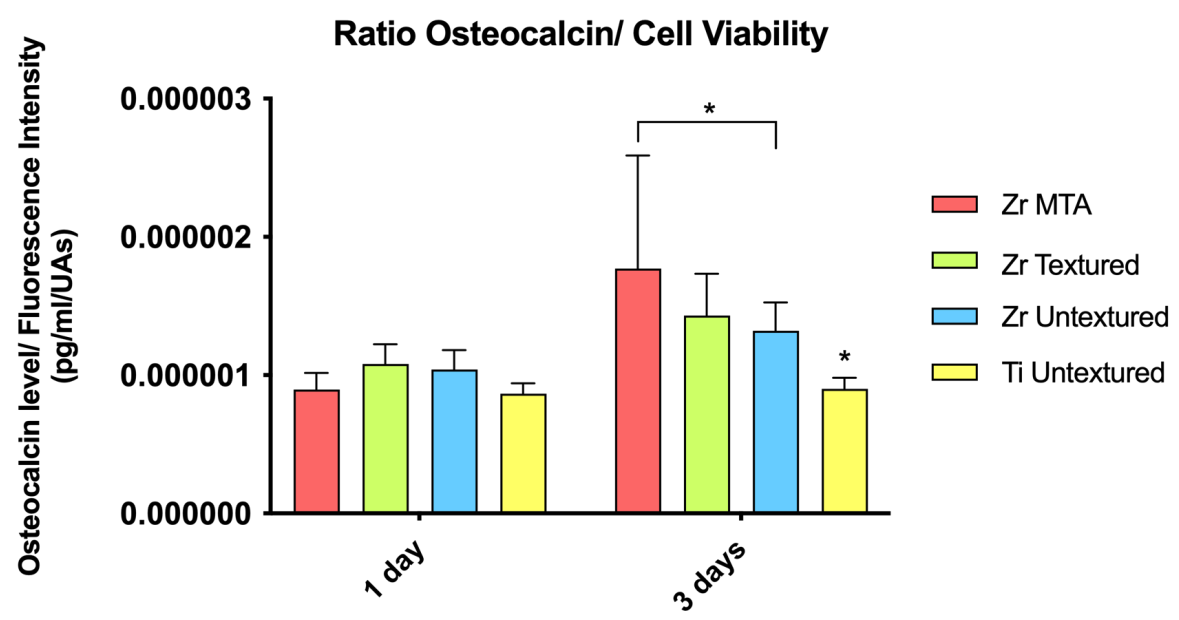
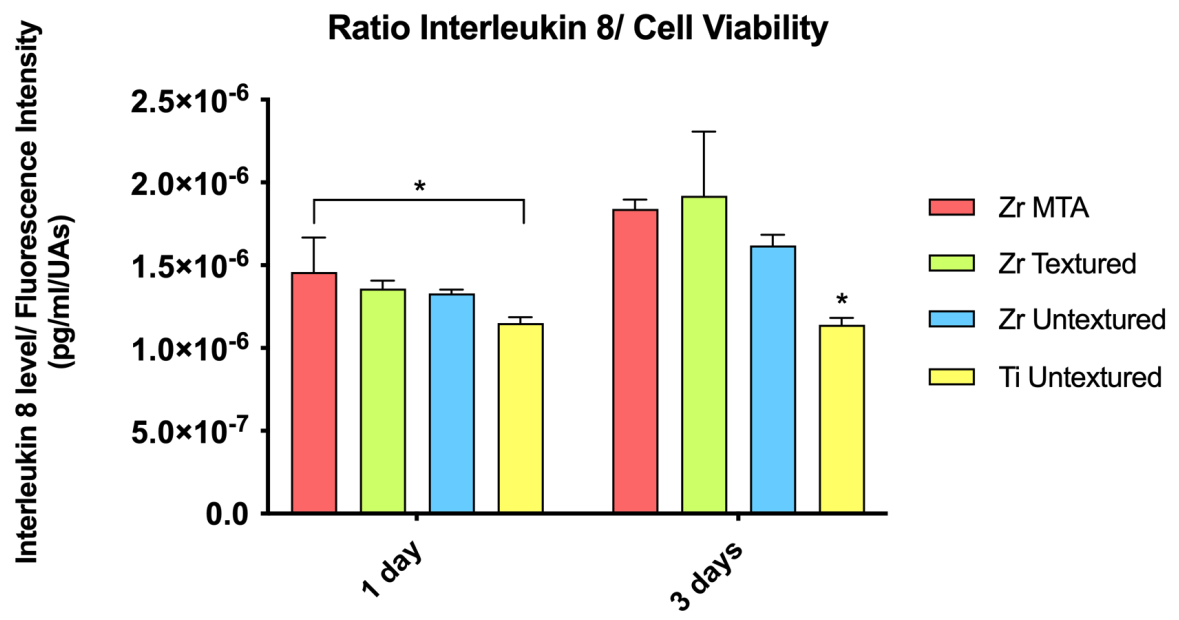
ANOVA with Tukey's post-hoc tests

Significance $p < 0.05$

Values presented as mean \pm standard deviation

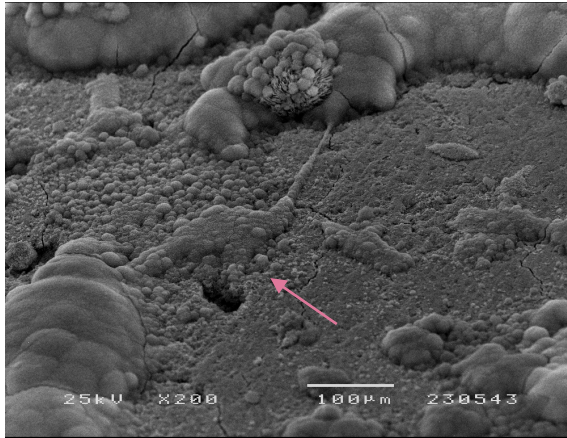
SAMPLE	ROUGHNESS – Ra (μm)	STANDARD DEVIATION (μm)
Zr MTA	0.31	0.11
Zr Textured	27.73*	3.22
Zr Untextured	0.19	0.14
Ti Untextured	0.49	0.14



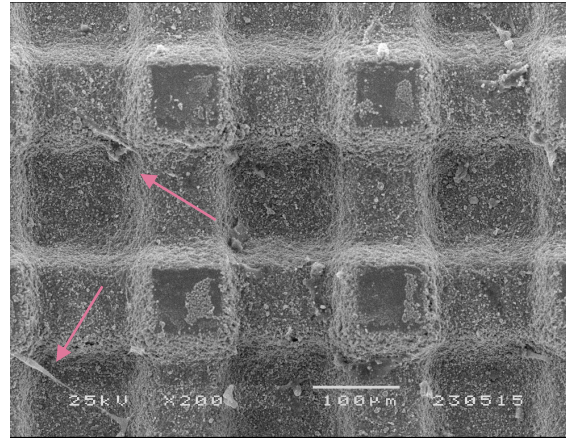


RESULTS

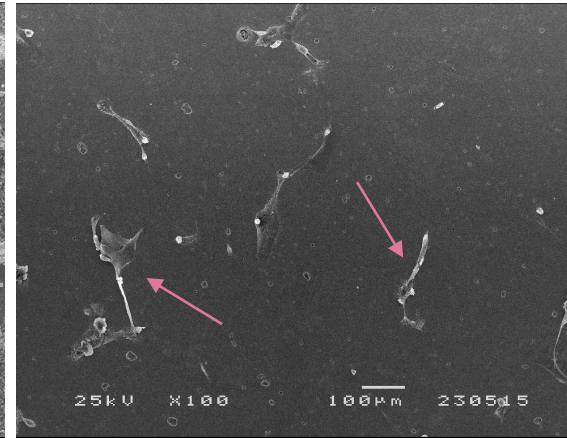
Zr MTA



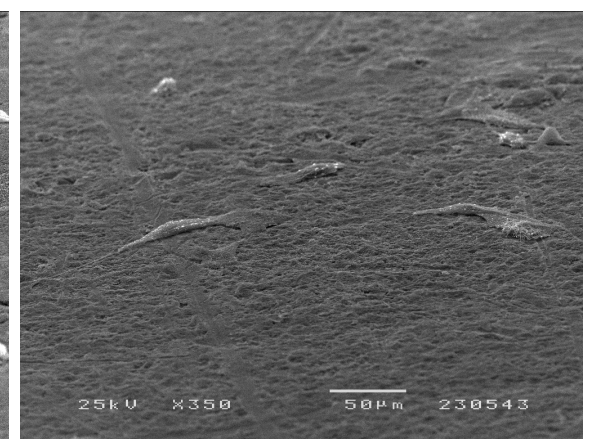
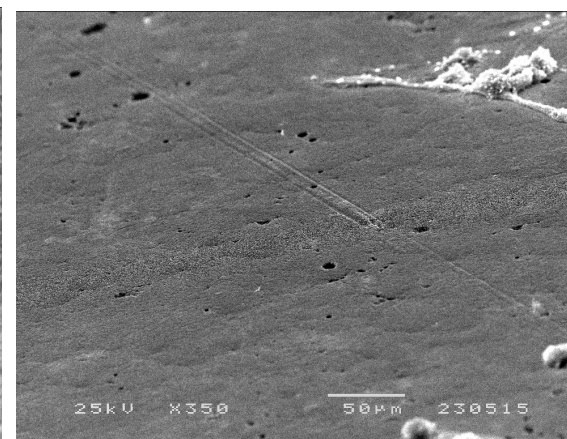
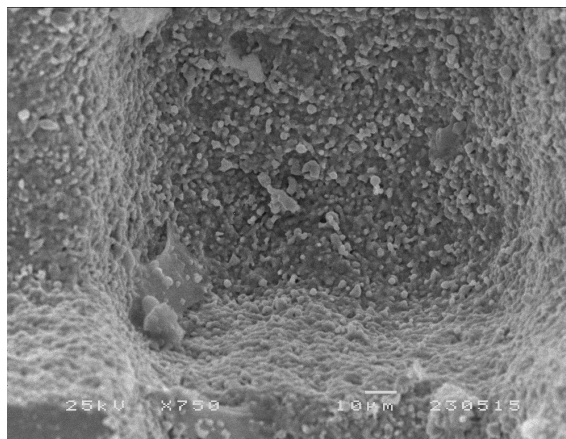
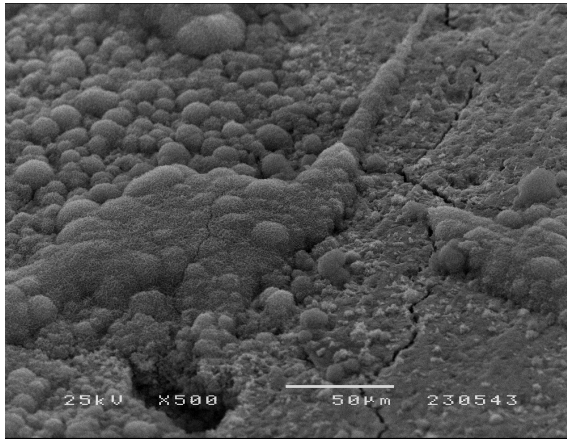
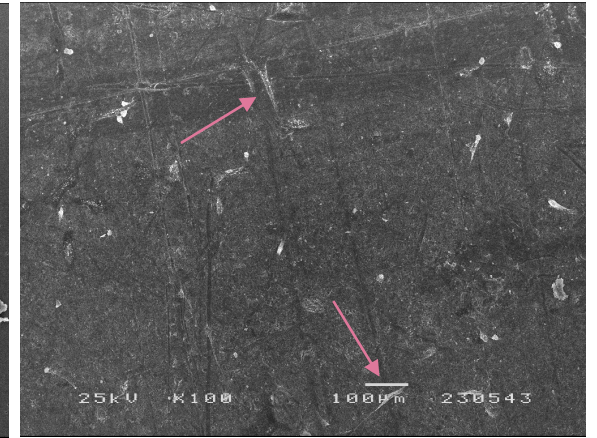
Zr Textured



Zr Untextured

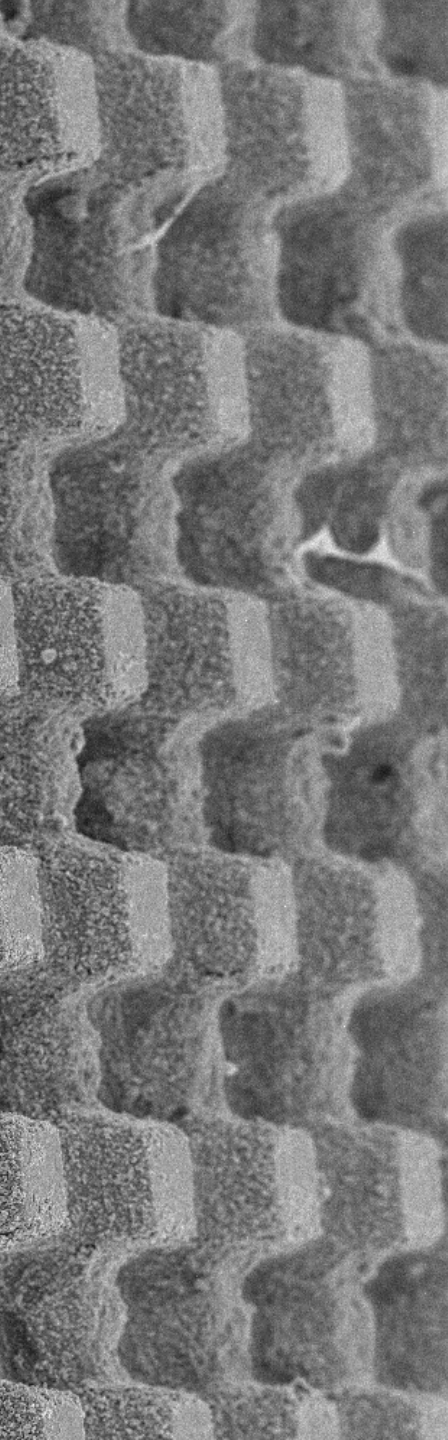


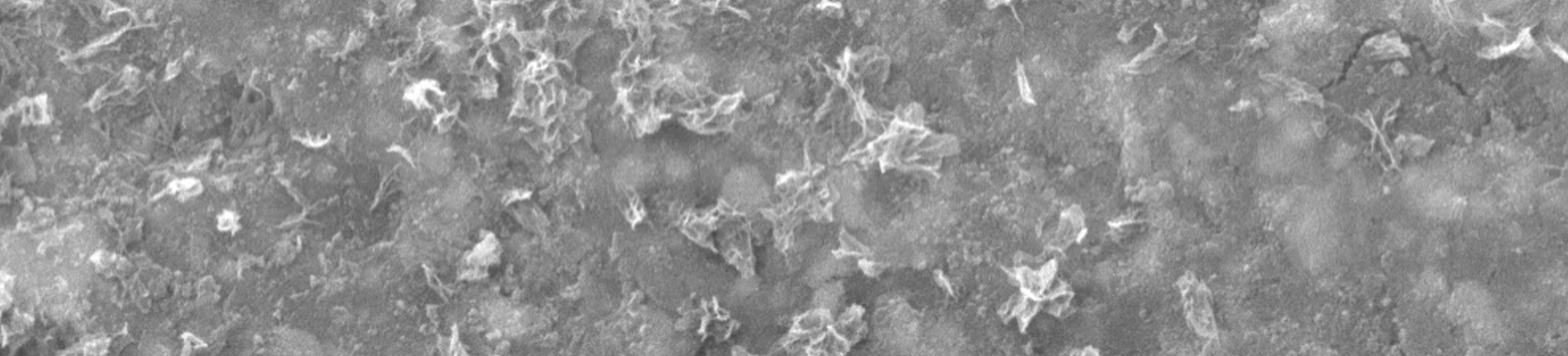
Ti Untextured



SEM

Discussion

- 
- Although the MTA-coated Zirconia samples were textured as a way of retaining MTA, after coating they showed similar roughness values to those of Zirconia and Titanium untextured samples.
 - The in vitro cellular viability of osteoblasts seems to be decreased when in contact with MTA on implant Zirconia surfaces.
 - Cytotoxicity?
 - Cell differentiation? – osteocalcin secretion... role of MTA???
 - Coating stability can be improved.
 - More studies are needed with new approaches for the incorporation/coating of MTA in implant surfaces



Despite the potential beneficial properties of MTA regarding biocompatibility and antibacterial capacity, the proposed strategy of coating MTA into implant surfaces does not seem to be beneficial for the cellular response. However, MTA increased differentiation in osteoblasts, suggesting that if coating stability is improved, potential biological benefits will be obtained.

Conclusion

ACKNOWLEDGMENTS



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Thank you!



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