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Epithelial Cell Adaptations on Nanoporous Surfaces

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Introduction

The existing literature shows **varying results** on the best surface texturization for peri-implant tissue health.[1]

Nonetheless, **nanoscale surface modifications** have previously been shown to favorably modify osteogenic cell behavior.[2]

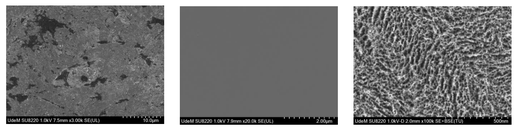
Our research examines epithelial cell response to two distinct titanium surface topographies: **polished, mirror-finish (Smooth)** and **acid-etched, nanoporous (Nano).**

Analyzed parameters include **cell size, spreading, and focal adhesion formation** to evaluate cell-surface interaction dynamics.

Methodology

- **Model: Human oral epithelial keratinocytes** grown on two distinct titanium surface topographies (Smooth, Nano).
- **Smooth disk preparation:** Commercially pure titanium disks underwent a three-step polishing process resulting in a completely **flat, untextured surface**.
- **Nanoporous disk preparation:** A subset of these smooth disks was treated via **oxidative nanopatterning** with an H2SO4/H2O2 50:50 V/V solution.
- **Scanning electron microscopy:** Cells were cultured for 72 hours, fixed, and imaged via scanning electron microscopy to assess **cell size and morphology**.
- **Immunofluorescence microscopy:** Cells were cultured for 72 hours, fixed, stained with rhodamine-phalloidin and anti-vinculin probes to assess **cell size and morphology**, and to visualize **actin networks and focal adhesions.**

SEM Visualisation: Surface Topographies

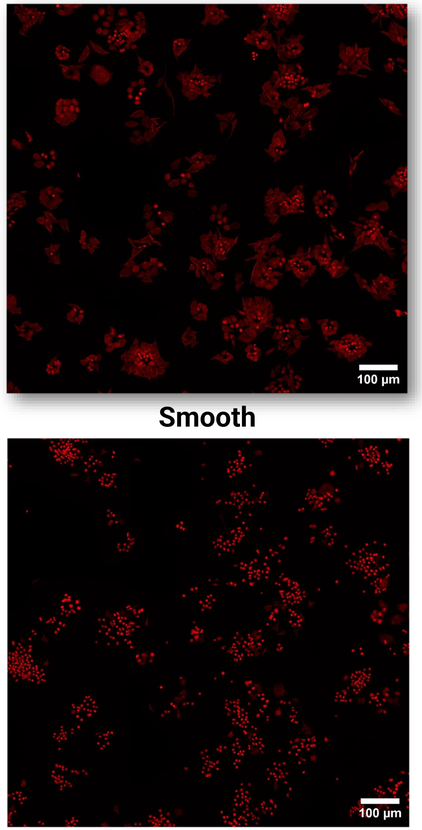


Results

Morphological observations and ongoing quantitative analysis indicate :

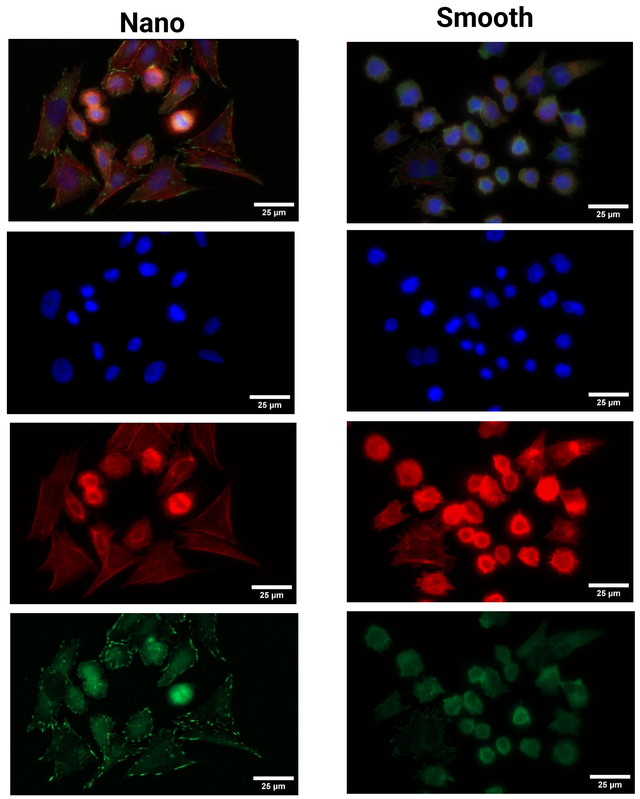
- **Greater cell size (~260%) and spreading** on the Nano surface compared to Smooth surface.
- **Different morphology** between the Nano and the Smooth surface.
- **Increased number and maturity of focal adhesions** on the Nano surface compared to the Smooth surface.
- **Increased surface coverage** on the Nano surface compared to the Smooth surface.
- **Greater frequency of spread cells (~11x)** on the Nano surface compared to the Smooth surface.

Immunofluorescence microscopy: Comparison of surface coverage



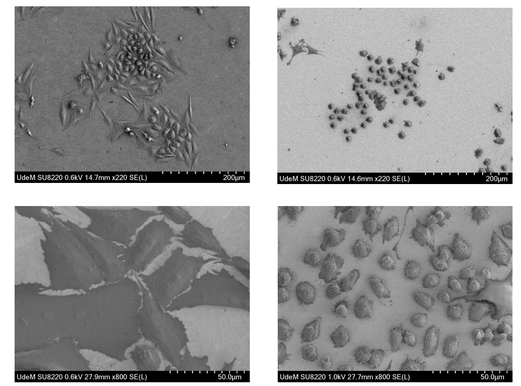
Red: Actin

Immunofluorescence microscopy: Comparison of focal adhesions



Blue: Nucleus Green: Vinculin Red: Actin

SEM Visualisation: Cell size and morphology



Discussion

- Nanoporosity promotes more **robust interactions** between epithelial cells and titanium surface, as evidenced by (i) an **increased quantity and quality** of focal adhesions and (ii) **a reorganized cytoskeleton**[3].
- **Enhanced cell anchorage and spreading** correlate with peri-implant epithelial tissue integrity[4].

Conclusion

Nanoporosity appears to **favorably modulate** epithelial cell behavior via **enhanced interactions** on the cell-surface interface.

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