Evaluate the cell adhesion force for HOS and fibroblast on the nano-metric roughness of Ti6Al4V

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Introduction:

The interface of biomaterial is considered a key factor for good osseointegration, the surface properties of an implant, such as wettability, surface energy, topography, roughness and nano-surface compositions all combined to impact on the initial cell responses. Mechanical, chemical, and biological surface modification methods aiming at improving the bioactivity, biocompatibility and corrosion resistance of titanium and titanium alloy were reported. This research investigates the effect of roughness changes at nano-metric scale on the surface properties and cell responses. We major evaluate the cell adhesion force for the shot-team and long-team responses of Murine NIH-3T3 fibroblasts and HOS on surfaces of various degrees in roughness.

Methods:

Stage 1: Samples preparation and characterization

Titanium-based alloys (Ti6Al4V) discs were prepared by wet grind, polish and clean. Each sample was passivated by 400°C air for 45 mins. Surface roughness and topography of the samples were measured by SPM.

Stage 2: Cyto-detachment test

(a) Each sample was put in culture plates. Murine NIH-3T3 fibroblasts and osteoblast-like HOS cell line were cultured on the disk for 3, 12, 24, 48 and 72 hours.

(b) The cyto-detacher consists of four components as shown in Fig. 1. The system maintains 5% CO_2 at 37°C.

(c) The maximum deflection at the cantilever's tip was identified by images.

(d) The adhesion force was estimated using Hooke's Law.

Results:

For the nano-surface of Ti6Al4V, we investigate the effect of nano-surface roughness of Ti-6Al-4V alloy on the shot-team and long-term responses of Murine NIH-3T3 fibroblasts and HOS. Ra values are between 2.75 nm to 30.34 nm.

(a) For Murine NIH-3T3 fibroblasts and HOS, cell adhesive force increases with the roughness at 3 hrs.

(b) For the long terms, the surface roughness increase, the cell adhesion force increases.

(c) Cell adhesion forces of HOS are stronger than 3t3 fibroblast.

Conclusions:

This study provided another method to evaluate the cell adhesion strength on the biomaterial by cyto-detacher. Cell adhesion strength served as a quantitative indicator of cyto-compatibility in-vitro

References:

1. Schwartz Z et al., J. Biomed. Mater. Res., 1996; 30:145.
2. Deok-Ho Kim et al., Annu. Rev. Biomed. Eng., 2009; 11:203.

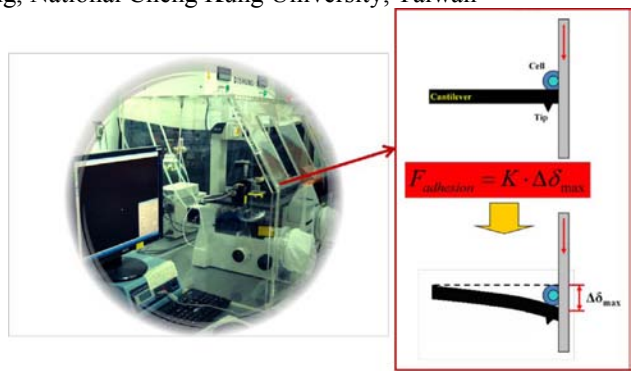

Figure 1. Major components of the cytodetachment apparatus.

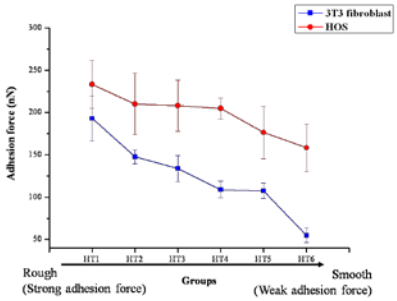

Figure 2. Cell adhesive force vs. Surface roughness

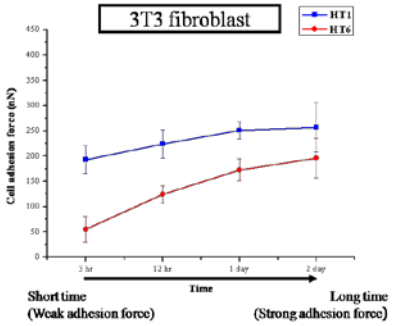

Figure 3. Cell adhesive force vs. Culture periods for 3T3

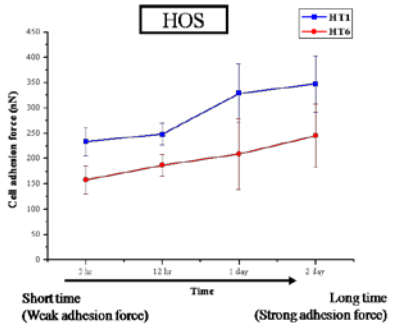

Figure 4. Cell adhesive force vs. Culture periods for HOS