**Introducing Human Primary Osteoblast Cytocompatibility to PEEK by Plasma Surface Modification**

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**Materials and Methods:** Injection moulded PEEK Optima™ discs (Invibio) with a 13mm diameter were modified by plasma treatment, and these were compared to Thermanox (THX) (Nunc) and standard medical grade micro-rough titanium (cpTi ISO 5832/2) (Synthes). Using an EMITECH RF plasma treater, the samples were exposed to varying treatment times. Surface chemical compositions of treated and untreated surfaces were characterised by XPS, wettability by contact angle, topographic changes by AFM and SEM. HOB cells isolated from human femoral heads removed during total joint replacement operations were grown to 70-80% confluency in DMEM (10% FCS in 5% CO₂ at 37°C), and plated at 10000 cells/cm². Alpha-MEM (0.1µM dexamethasone and 10mM beta-glycerophosphate) was used as mineralisation media over the 28 day experiments. Cell functionality was assessed by alkaline phosphatase expression (ALP), phenotypic gene expression by qPCR, mineralisation by Alizarin red S (ARS) staining of calcium, cell attachment by SEM and cell density through the alamarBlue™ assay, sampling was performed at 1, 7, 14, 21 and 28days.

**Results:**

Surface chemical compositions of treated and untreated surfaces were characterised by XPS, wettability by contact angle, topographic changes by AFM and SEM. HOB cells isolated from human femoral heads removed during total joint replacement operations were grown to 70-80% confluency in DMEM (10% FCS in 5% CO₂ at 37°C), and plated at 10000 cells/cm². Alpha-MEM (0.1µM dexamethasone and 10mM beta-glycerophosphate) was used as mineralisation media over the 28 day experiments. Cell functionality was assessed by alkaline phosphatase expression (ALP), phenotypic gene expression by qPCR, mineralisation by Alizarin red S (ARS) staining of calcium, cell attachment by SEM and cell density through the alamarBlue™ assay, sampling was performed at 1, 7, 14, 21 and 28days.

**Discussion/Conclusions:** Surface modification of PEEK by oxygen plasma treatment can be used to increase the surface energy and thereby aid the adhesion of HOB cells. This surface modification has led to more characteristic osteoblast behaviour of the HOB cells, indicating that these treated surfaces are likely to improve bony integration to implants.

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**Figure 1:** Surface oxygen concentration of PEEK surfaces with increasing plasma treatment time.

**Figure 2:** AFM images of a) the untreated PEEK as a relatively smooth surface, b) the surface after 10min treatment showing no significant change in the surface roughness, c) the surface after 30min treatment, where surface modification has started to alter the surface topography, and d) a 5µm scan of the same region showing the pits created.

**Figure 3:** In vitro mineralisation determined by Alizarin red S staining of calcium depositions produced by the HOB cells. AALP expression was observed to be more characteristic towards osteoblast phenotype on the treated PEEK surfaces, than untreated PEEK over the 28 day experiments. Initial findings indicate that collagen type I and osteocalcin gene expression were upregulated on the treated PEEK surfaces compared to untreated PEEK surfaces by day 7. Nodule formation quantified by dissolving the ARS stain was found to be greater on the PEEK surfaces than on the THX surfaces, and similar to the levels on the cpTi surfaces (Fig 3). The level of mineralisation was higher on the treated PEEK surfaces from 7 days onward, indicating that the cells had started to mineralise earlier on these treated surfaces, and showed similar levels to cpTi throughout the 28 day experiments.

**References:**