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EARLY OSTEOGENIC RESPONSE OF OSTEOPROGENITOR CELLS ON MODIFIED TITANIUM IMPLANT SURFACES LEADS TO IMPROVED OSTEOGENESIS

[1]N. CHAKRAVORTY*, [1]I. PRASADAM, [2]S. IVANOVSKI & [1]Y. XIAO
[1] Institute of Health and Biomedical Innovation, Queensland University of Technology, Australia
[2] School of Dentistry and Oral Health, Centre for Medicine and Oral Health, Griffith University, Australia

Background
Implant surface micro-roughness and hydrophilicity are known to improve the osteogenic differentiation potential of osteoprogenitor cells. This study was aimed to determine whether topographically and chemically modified titanium implant surfaces stimulate an initial osteogenic response in osteoprogenitor cells, which leads to their improved osteogenesis.

Methods
Statistical analysis of microarray gene expression profiling data available from studies (at 72 hours) on sand-blasted, large grit acid etched (SLA) titanium surfaces was performed. Subsequently, human osteoprogenitor cells were cultured on SLActive (hydrophilic SLA), SLA and polished titanium surfaces for 24 hours, 3 days and 7 days. The expression of BMP2, BMP6, BMP2K, SP1, ACVR1, FZD6, WNT5A, PDLIM7, ITGB1, ITGA2, OCN, OPN, ALP and RUNX2 were studied using qPCR.

Results
Several functional clusters related to osteogenesis were highlighted when genes showing statistically significant differences (from microarray data at 72 hours) in expression on SLA surface (compared with control surface) were analysed using DAVID (online tool). This indicates that differentiation begins very early in response to modified titanium surfaces.
At 24 hours, ACVR1 (BMP pathway), FZD6 (Wnt pathway) and SP1 (TGF-β pathway) were significantly up-regulated in cultures on the SLActive surface compared to the other surfaces. WNT5A and ITGB1 also showed higher expression on the modified surfaces.
Gene expression patterns on Day 3 and Day 7 did not reveal any significant differences.

Conclusion
These results suggest that the initial molecular response of osteoprogenitor cells to modified titanium surfaces may be responsible for an improved osteogenic response via the BMP and Wnt signalling pathways.