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A Comparative analysis of effect of Ultra High Molecular Weight Polyethylene on osteoblastic activity on Titanium and Zirconia surfaces – An in vitro study

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ABSTRACT

Background: It is essential to improve osseointegration in dental implants and one suggested method is by coating ultra-high molecular weight polyethylene (UHMWPE) and hydroxyapatite nanoparticles (HA/HAP) on the surface. This modification is necessary due to the lack of osseointegration in patients with osteopenia or poor bone quality, who require longer waiting times for implant placement. Previous studies have optimized implant surface chemistry and topography.

Objectives: This study aims to optimize osteoblastic migration, adhesion, proliferation, and differentiation leading to improvement in osseointegration which will result in reduced chances of implant failure.

Methods: 60 discs of 6 mm diameter and 8 mm thickness were divided into two groups: machine milled zirconia and commercially pure titanium Ti-6Al-4V. The zirconia discs were treated with sandblasting and acid etching, UHMWPE, and HAP, while Ti-6Al-4V discs were treated with sandblasting and acid etching, UHMWPE, and HAP.

Three in-vitro analyses were conducted to determine the relative effects of ultra-high molecular weight and hydroxyapatite on titanium and zirconia: cell adhesion, cell differentiation using alkaline phosphatase, and osteocalcin activity kit.

After surface modification, dental implants can be examined for surface morphology and topography using a scanning electron microscopy (SEM).

Comparison of six groups scores was done by one way ANOVA and Pair wise comparisons of six group scores was done by Tukey's multiple post hoc procedure.

Results: The comparative study between titanium (Ti) and zirconia (Zr) implant materials suggests promising results for the Ti groups while also highlighting the potential of Zr as a future implant material.

Conclusion: This study suggests that surface treatment and coating with UHMWPE and hydroxyapatite significantly enhance osteoblastic activity on both zirconia and titanium discs, with titanium showing slightly better results.

Keywords: Titanium, zirconia, implant, osseointegration, ultra-high molecular weight polyethylene, hydroxyapatite nanoparticles.

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