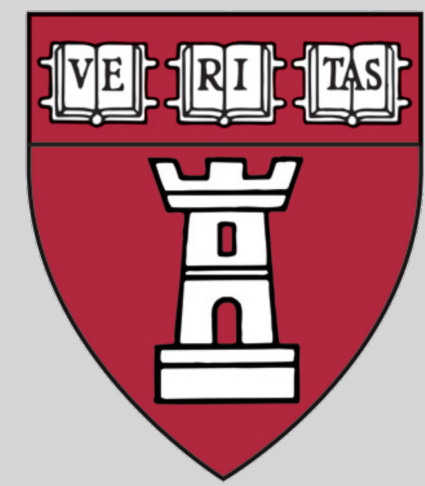




Plasma Treatment Removes Implant Surface Contaminants and Improves Biocompatibility

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Introduction:

Surface modification of titanium implant and abutment has been extensively studied to improve the longevity and long-term outcome of implant therapy. Plasma treatment on titanium surfaces has the potential of becoming a chair-side treatment to bio-activate and regenerate titanium surfaces prior to implant surgery. This *in-vitro* study aims to evaluate the effects of plasma treatment on titanium surfaces and the cellular response of murine fibroblasts and osteoblasts on treated surfaces.

Materials and Methods:

Machined and rough-surfaced titanium discs were treated with plasma and subsequently evaluated for architectural changes under scanning electron microscopy (SEM) and elemental changes under energy dispersive spectroscopy (EDS). The discs were also evaluated for changes in surface hydrophilicity using contact angle analysis. Lastly, murine fibroblast and osteoblast were seeded for 2 hours to observe adhesion and proliferation quantitatively and qualitatively. Quantitative analysis was done using cell viability assays to look at cell attachment, while qualitative analysis was done using SEM to observe cell morphology in response to treatment. Statistical analyses were conducted using one-tailed unpaired t-test at 95% CI.

Results:

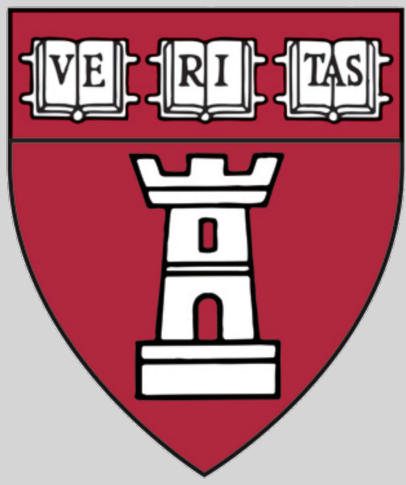
SEM analysis showed minimal to no surface changes after plasma treatment. There was, however, a notable decrease in the amount of carbon buildup on the disc after plasma treatment. Hydrophilicity of the titanium surface significantly improved after treating with plasma. Fibroblast and osteoblast behavior also differ between control and plasma-treated discs. Cell adhesion to the disc improves with plasma treatment, with fibroblast cells reaching statistical significance ($p < 0.05$) in favor of plasma treatment. Under SEM imaging, fibroblast morphology shows more activated fibroblast cells on surfaces treated with plasma.

Conclusion:

Plasma treatment does not significantly alter implant surface architecture. It does, however, significantly improve surface hydrophilicity and improves cell adhesion during early time points. Plasma treatment also seems to provide a surface that is beneficial for fibroblast cell activation compared to control samples. The results of the study demonstrated that plasma treatment has the potential to be an effective chair-side treatment to improve surface biocompatibility and long-term implant outcome.

Plasma treatment on titanium disc





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RESULTS

Plasma treatment does not significantly alter titanium surface architecture

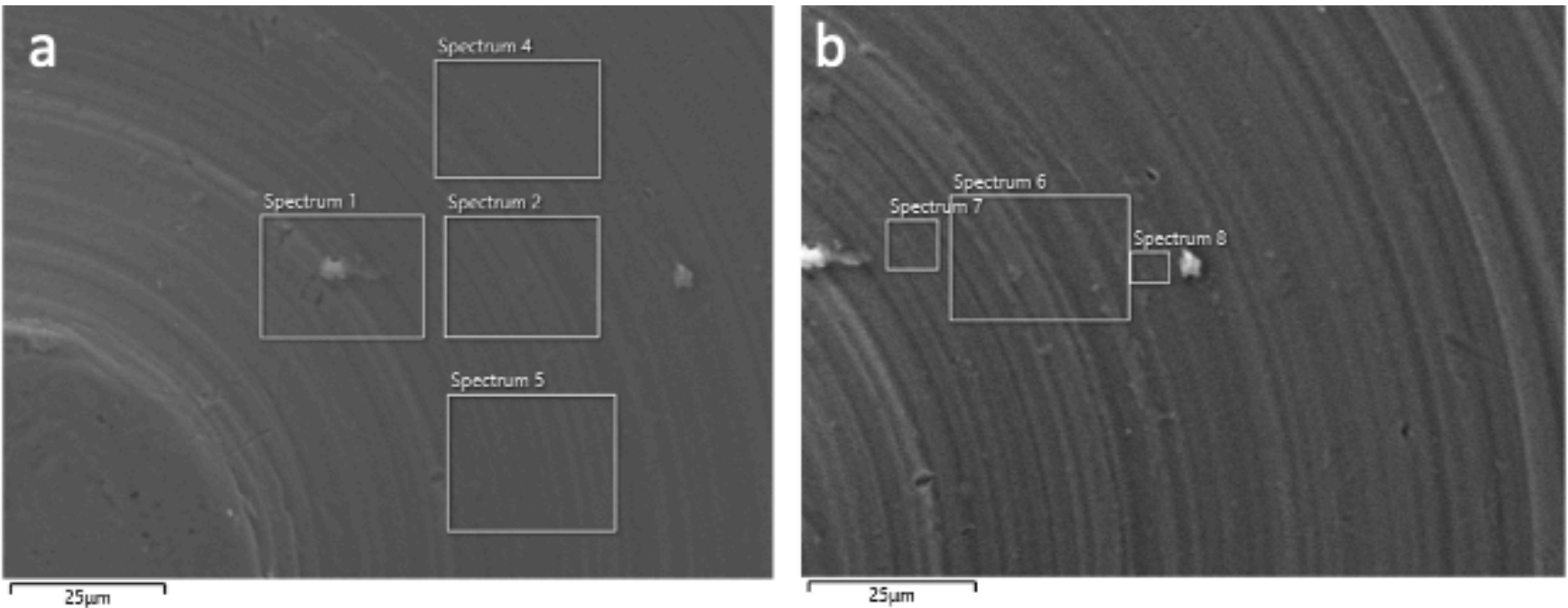


Figure 1a. Machined surface (control - no plasma) at 1000x magnification. Note the two points of contamination as reference point for SEM imaging.

Figure 1b. Machined surface (control - after plasma) at 1000x magnification.

Plasma treatment reduces the amount of carbon build-up on titanium surfaces

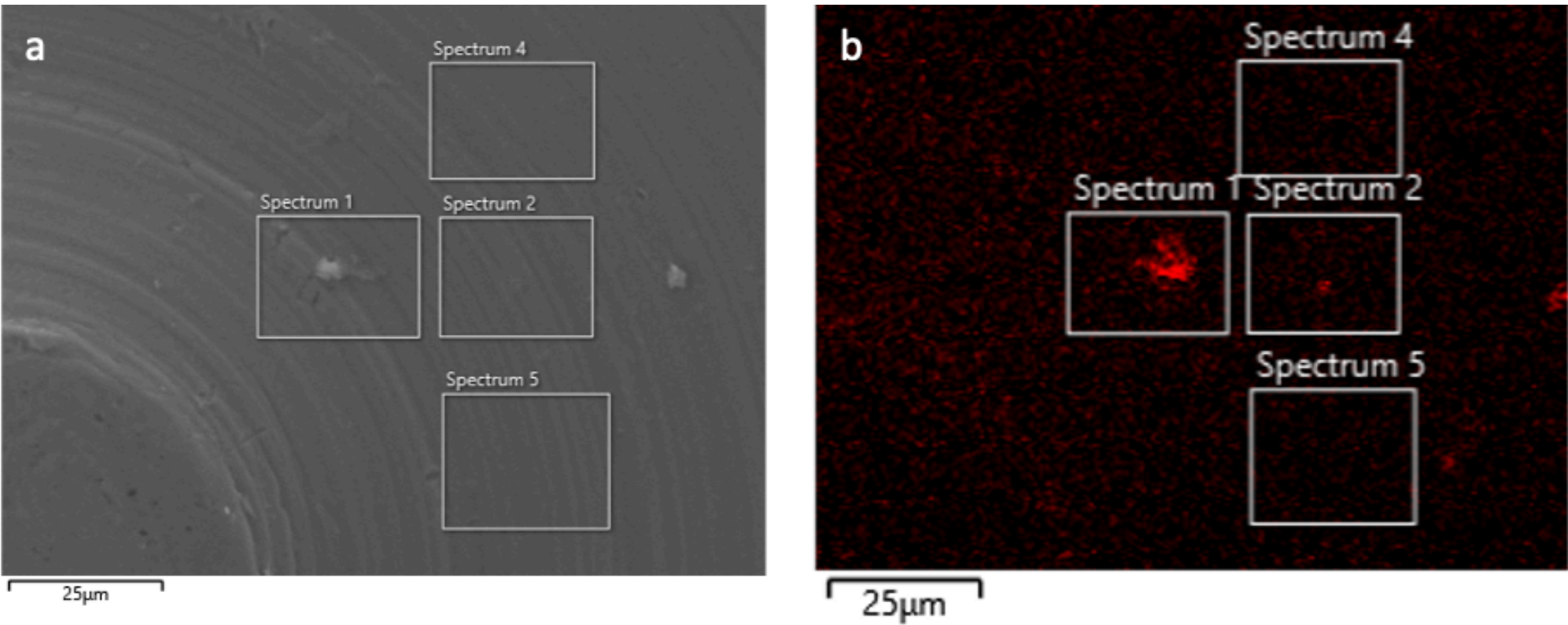
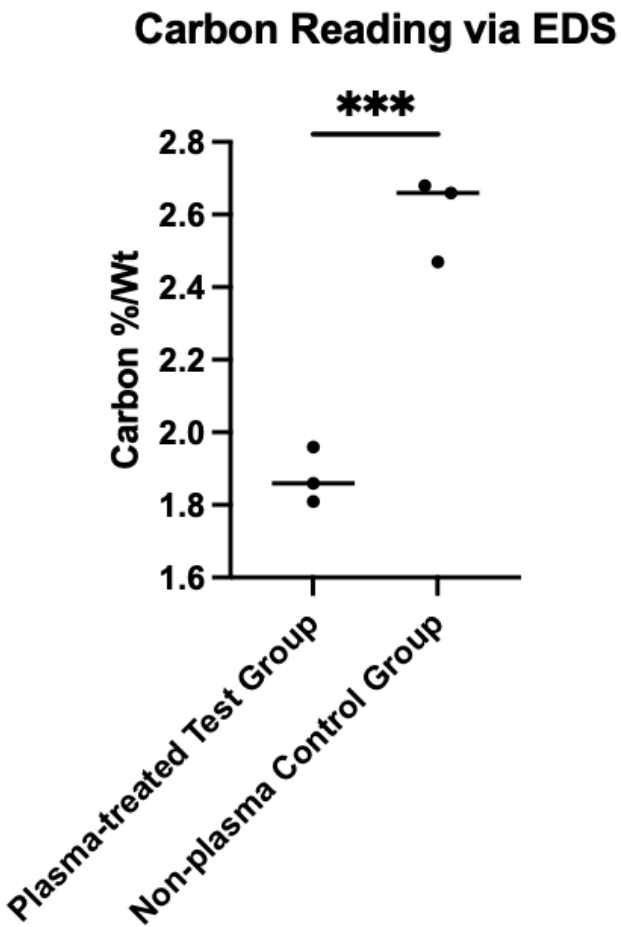
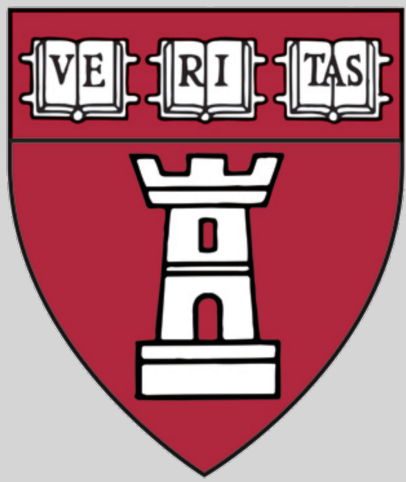


Figure 2a. Machined surface imaged with SEM. Note the presence of surface contaminants.

Figure 2b. Machined surface imaged with EDS for carbon species. The surface contaminants have a high build-up of carbon. There is also an abundance of carbon species across the rest of the disc





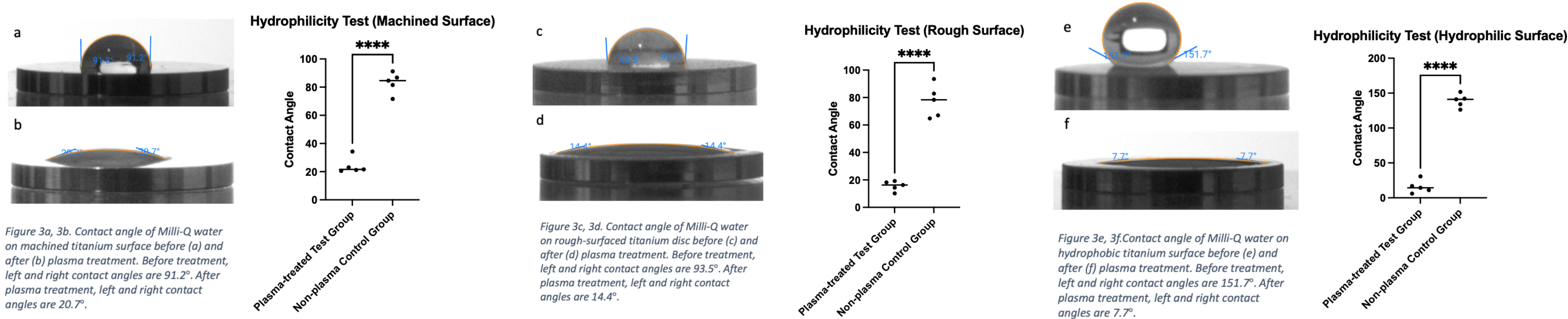
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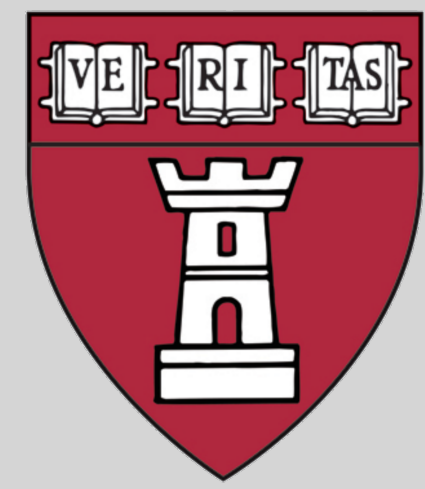
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RESULTS

Plasma treatment increases titanium surface hydrophilicity





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RESULTS

Fibroblast cells cultured on plasma-treated titanium surfaces display “activated” cell morphology

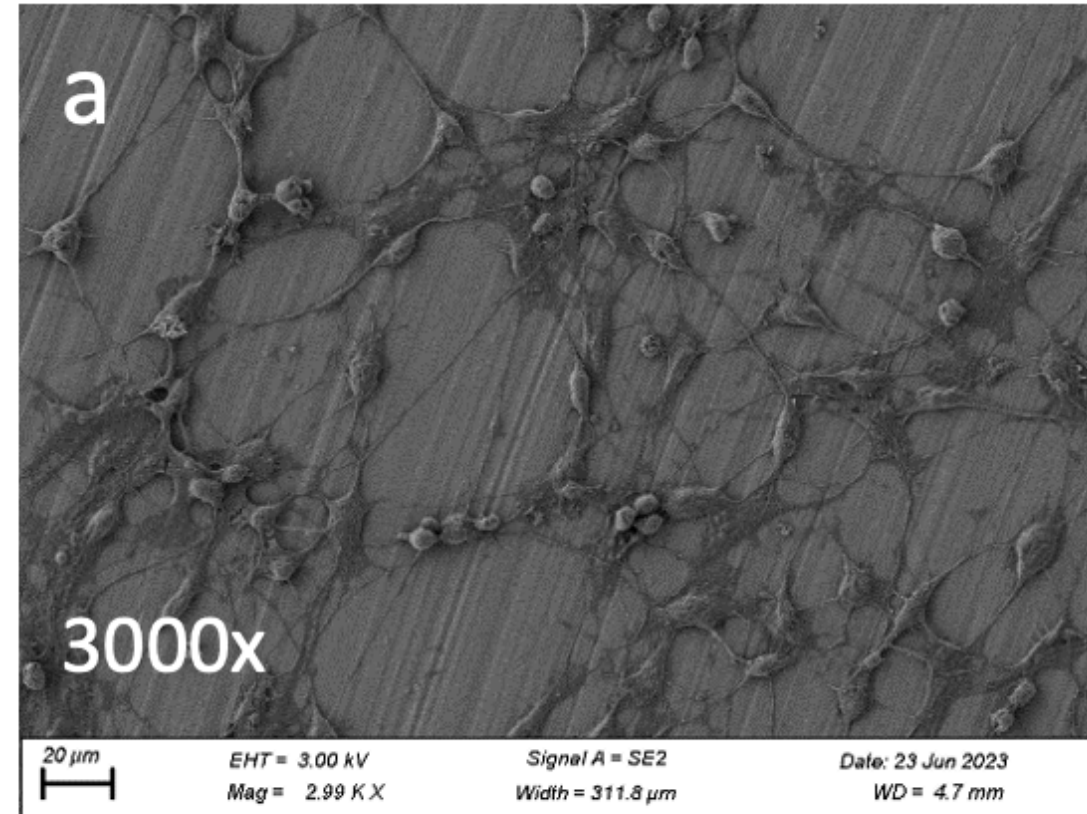


Figure 4a. Machined surface (control - no plasma) at 3000x magnification

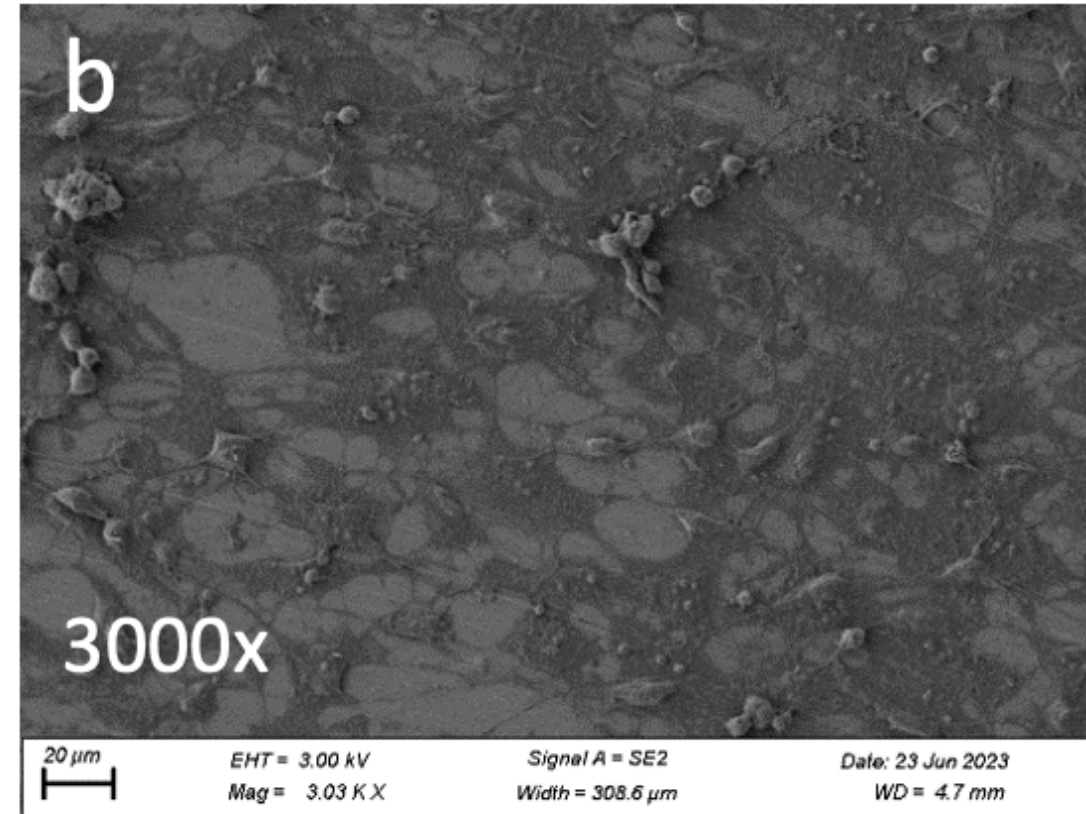


Figure 4b. Machined surface (test - plasma) at 3000x magnification

Fibroblast and osteoblast cells cultured on plasma-treated titanium surfaces have better adherence 2 hours after cell seeding

