

Aim

The aim of this study is to evaluate and compare alterations on titanium and zirconia disc surfaces as a result of Er:YAG surface treatment.

Materials & Methods

A total of 16 titanium (Ti-Zir) and zirconia (Y-TZP) discs (5mm in diameter) were used (Figure. 1). Eight of those discs (test group: 4 titanium and 4 zirconia) were irradiated with Er:YAG laser (2940 nm) under the manufacturer's suggested peri-implant surface decontamination settings (120 mJ, 20 Hz in MSP mode for 60 sec) (Figure. 2). The remaining 8 discs (4 titanium and 4 zirconia) were used as controls. The treated/test and untreated/control zirconia and titanium discs were evaluated with:

- 1) Scanning electron microscopy (SEM); to assess any alterations on the surface morphology.
- 2) Energy dispersive X-ray spectroscopy (EDX); to identify any elemental differences between the control and irradiated surfaces (weight %).
- 3) Atomic force microscopy (AFM); to measure nanoscale differences between the surfaces.



Figure (1):
Zirconia & titanium discs

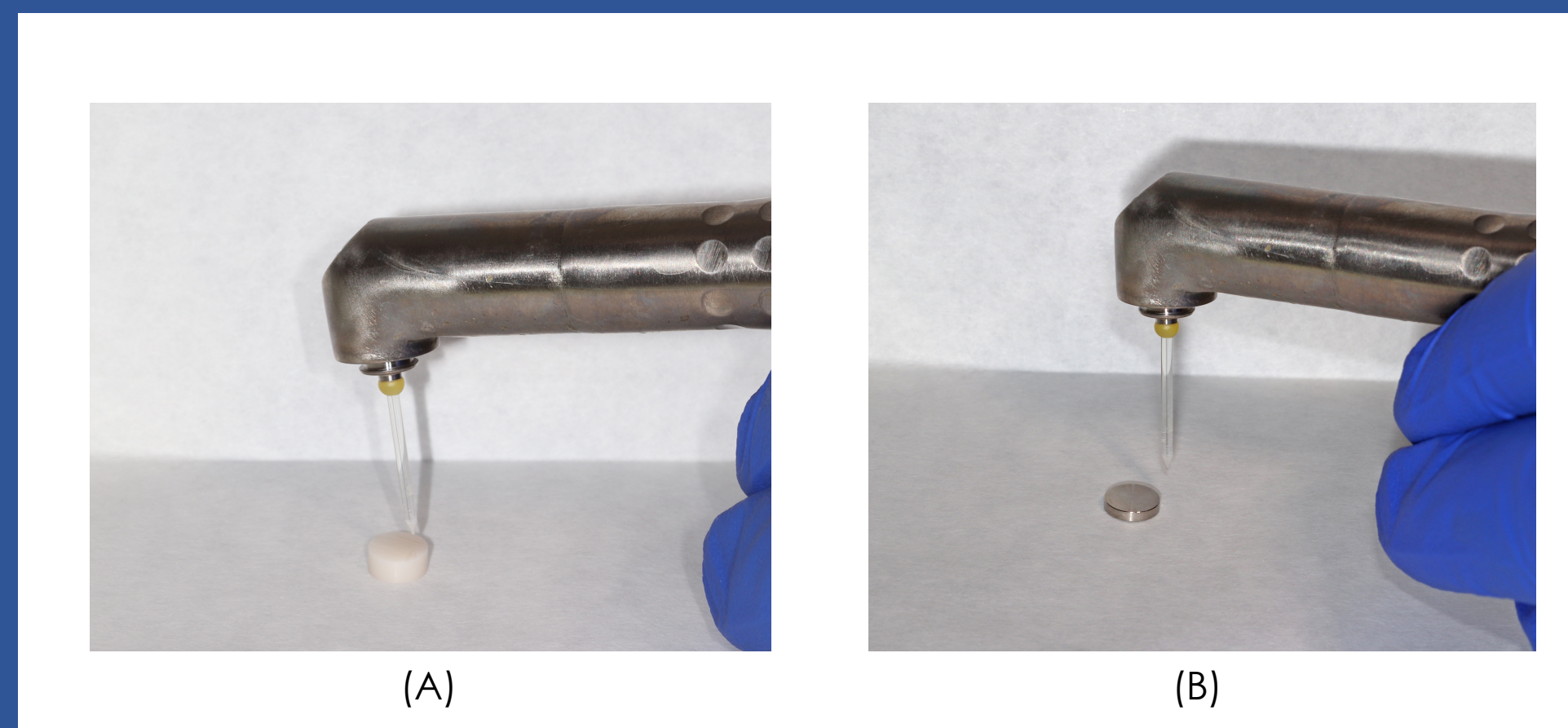


Figure (2):
Zirconia (A) and titanium (B) discs irradiated with Er:YAG laser

Results

SEM examination showed that Er:YAG laser irradiation of both implant surfaces resulted in visible alterations when compared to the control samples. Occasional scratch lines, pits, and particles were observed at the recommended settings, across the surface of both materials (Figure. 3). EDX elemental surface analysis showed no significant differences in both material groups. Specifically, the titanium disc (Ti-Zir) group presented with 85.34 ± 0.42 weight % of titanium and 14.59 ± 0.39 weight % of zirconia for the control group and 85.88 ± 0.44 and 14.12 ± 0.44 for the test group respectively (titanium $p=0.34$, zirconia $p=0.35$). Similarly, the zirconia disc (Y-TZP) group showed no significant differences, with 80.15 ± 0.11 weight % of zirconia and 7.47 ± 0.30 weight % of yttrium for the control group, and 73.34 ± 8.75 , and 7.20 ± 0.39 for the test group respectively (zirconia $p=0.36$, yttrium $p=0.30$). AFM analysis showed no statistically significant differences between the average surface roughness values of treated and control titanium and zirconia disc surfaces respectively ($p>0.05$) (Figures 4&5).

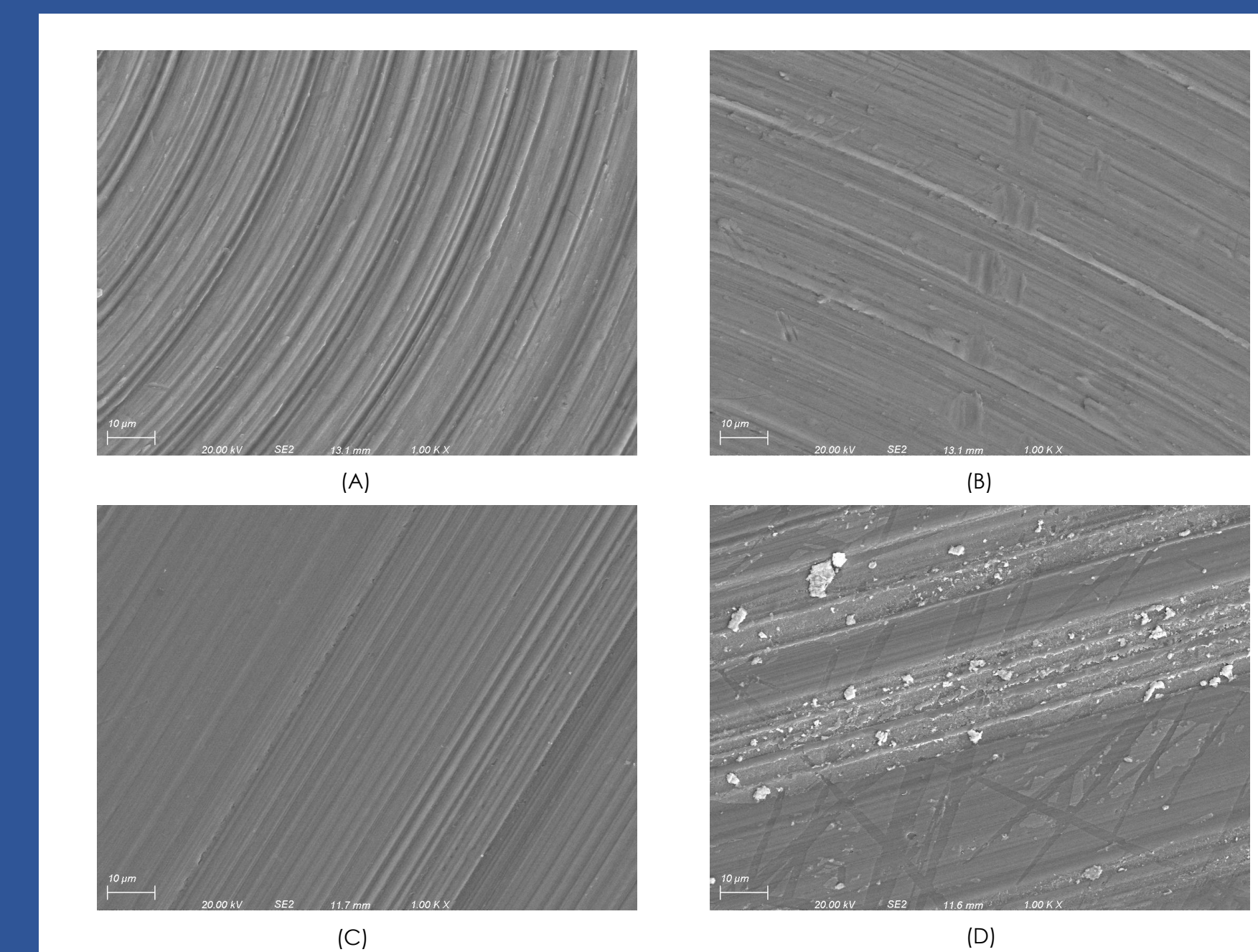


Figure (3): SEM images of the disc surfaces
A) Titanium control B) Titanium test
C) Zirconia control D) Zirconia test

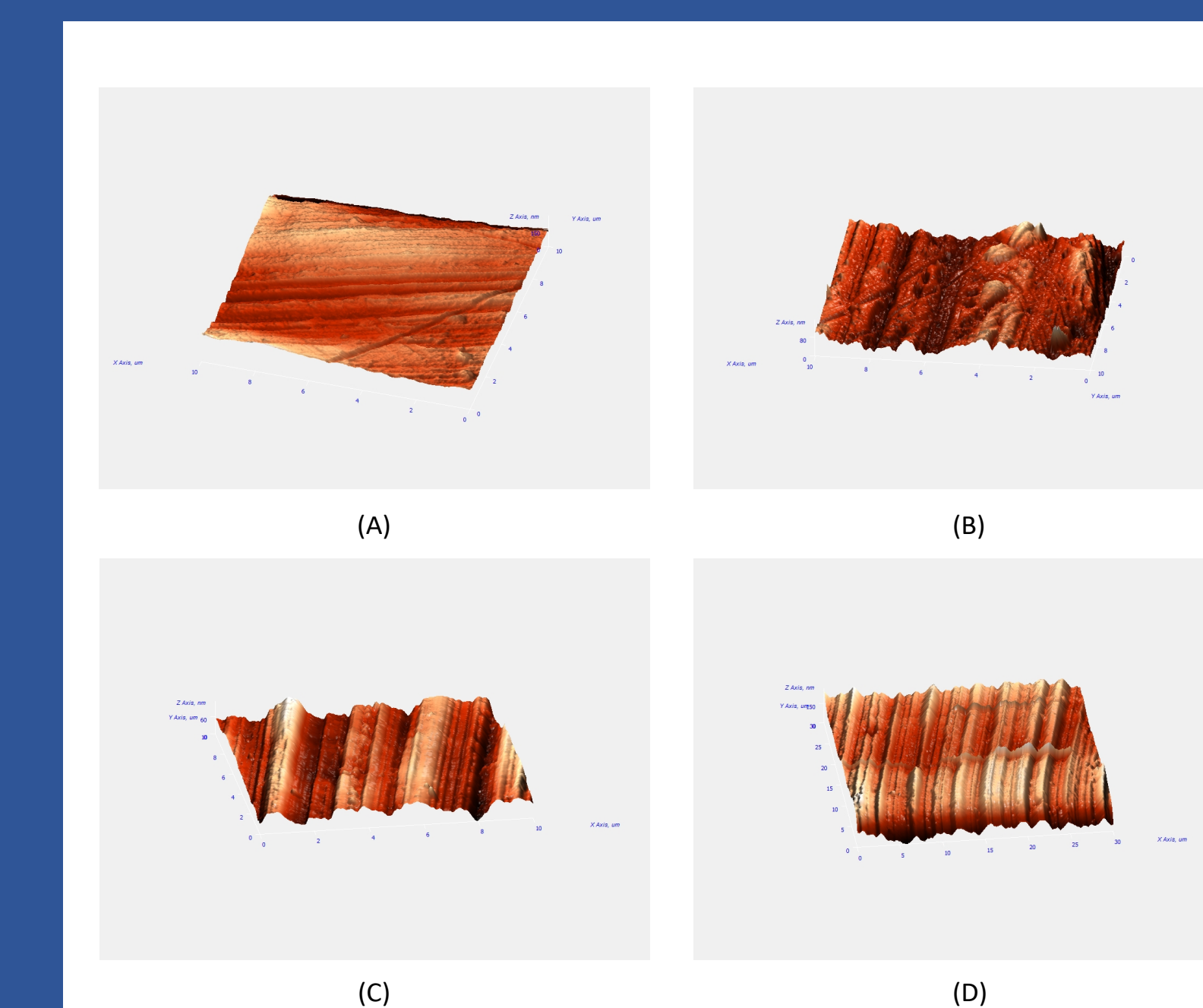


Figure (4): 3D Surface topography (AFM)
A) Titanium control B) Titanium test
C) Zirconia control D) Zirconia test

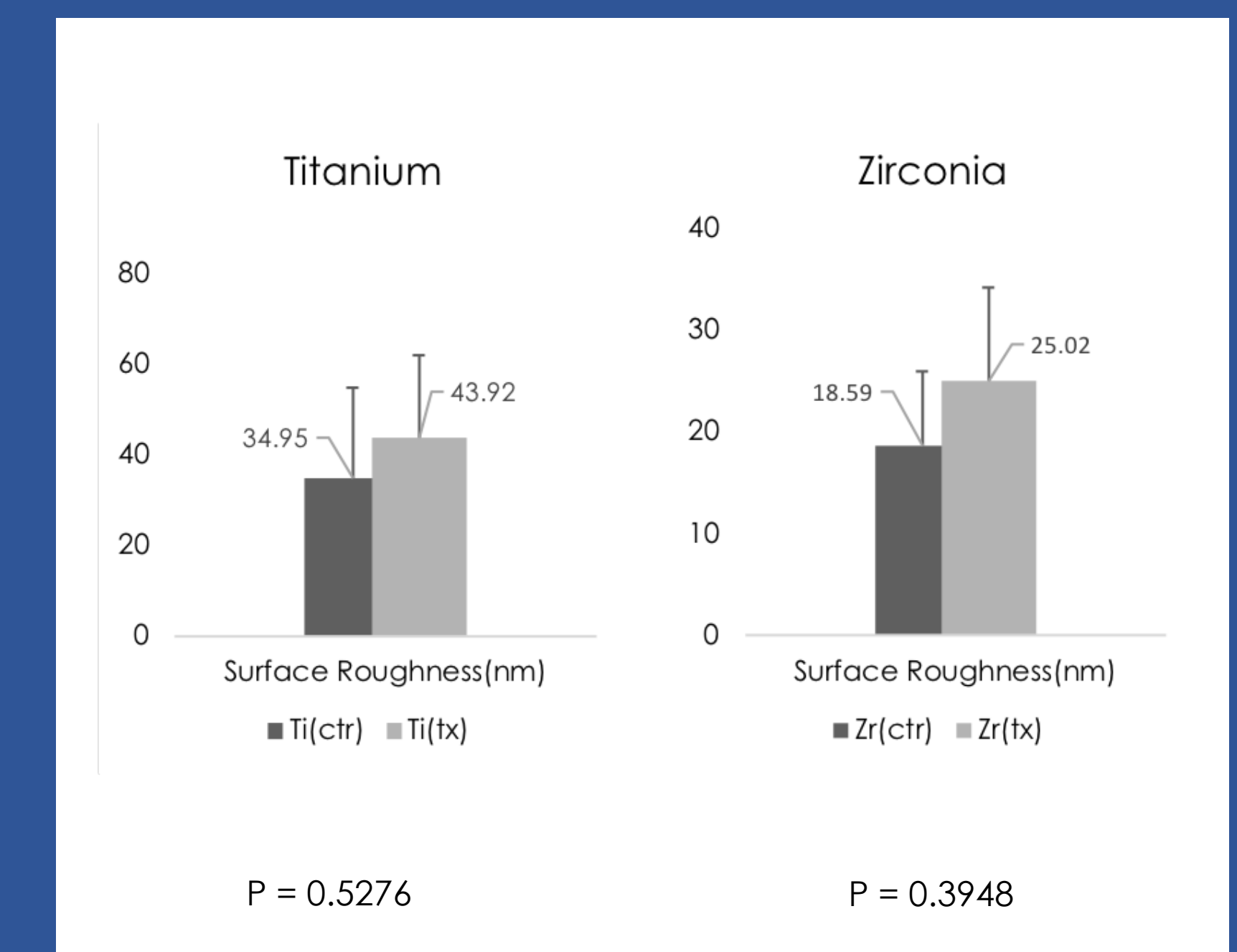


Figure (5): Average surface roughness (Sa) (AFM)
A) Titanium B) Zirconia

Conclusion

Even though SEM examination revealed visual changes after laser treatment, no significant differences were found for both surface elemental changes and surface roughness values between control and test groups. Er:YAG laser used at 120 mJ, 20 Hz in MSP mode for 60 sec demonstrates minimal surface morphology alterations on both titanium and zirconia implant surfaces.