Bacterial Adhesion to Different Dental Implant Collar Surfaces: An *In-vitro* Comparative Study

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Background:

- Various implant collar surface modifications have been employed by dental implant manufacturers, aiming at enhanced osseointegration or soft-tissue attachment when placed subcrestally or supracrestally, respectively.
- Modified collar surfaces have different surface characteristics, such as roughness, that may promote bacterial attachment, and potentially lead to peri-implantitis and implant failure.

Aim:

To investigate the effect of surface roughness on the amount and pattern of bacterial adhesion to different dental implant collar surfaces.

Table 1: Implant systems tested

Implant Systems	Implant Collar Surface	Sa (µm)	Manufacturer	Dimensions (Ø x Length mm)
Osseotite® Tapered Certain®	Machined*	0.15 ± 0.02	Zimmer Biomet	4.0 x 13
Osseotite Tapered Certain	Dual acid etched (DAE)	0.53 ± 0.02	Zimmer Biomet	4.0 x 13
Tapered Screw-Vent®	Grit-blasted (MTX®)	0.72 ± 0.05	Zimmer Biomet	4.1 x 15
NobelActive® Internal RP	Anodized TiUnite® (TiU)	1.11 ± 0.15	Nobel Biocare	4.3 x 13
OsseoSpeed™ EV	Titanium oxide blasted and fluoride etched (OS)	1.19 ± 0.12	Densply Sirona	4.2 x 13
Alvim CM	Sand blasted and acid etched Acqua™ (Acqua)	1.45 ± 0.02	Neodent	4.3 x 13
Bone Level Tapered SLA®	Alumina oxide blasted and etched (SLA)	1.49 ± 0.24	Straumann	4.1 x 12
Tapered Internal Implant Laser-Lok®	Laser textured (LT)	3.78 ± 0.18	Biohorizons	4.2 x 12

Different implant collar surfaces demonstrated various degrees of roughness and surface topography. **Zimmer Biomet Implant collar surfaces (i.e. DAE and MTX) have Sa values less than 1um (Table 1 and Figure 1).**
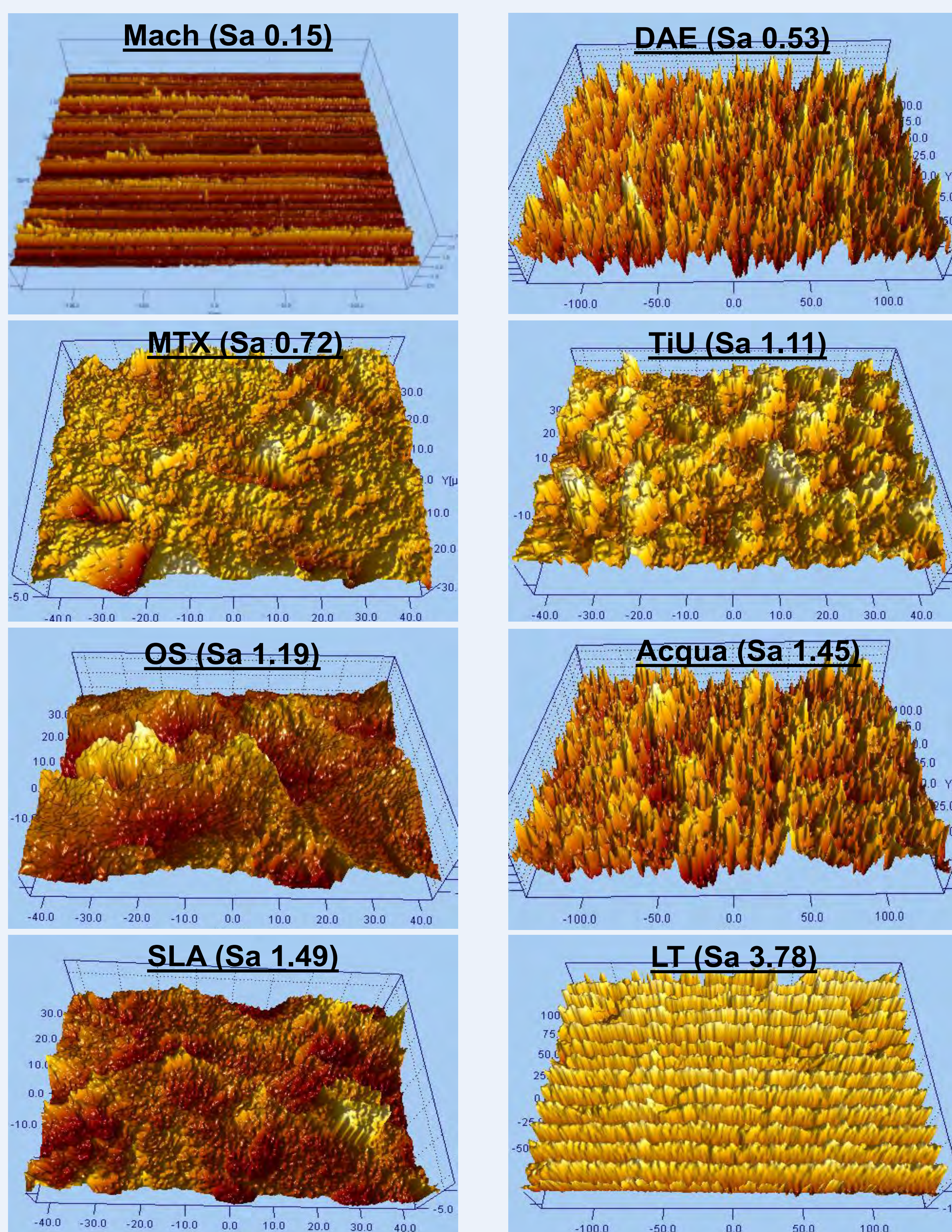

Figure 1: Interferometry maps of implant collar surfaces

No significant differences were observed in the bacterial adhesion on the Zimmer Biomet Implant collar surfaces when compared to the machined surface.
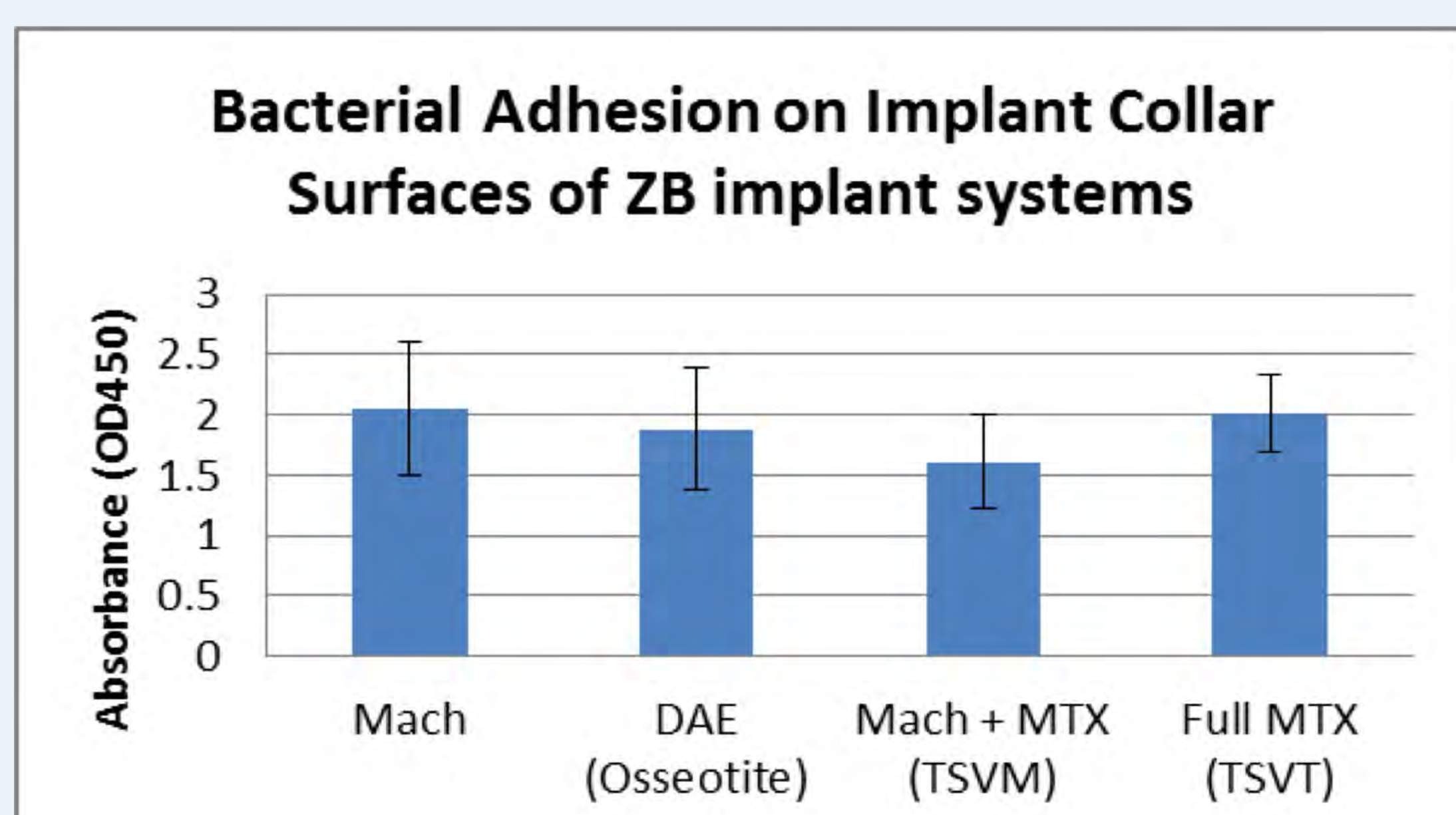

Figure 2: Bacterial adhesion on the collar regions of Zimmer Biomet Implant systems including Osseotite Tapered Certain, TSVM (0.5mm machined collar, MTX surface and microgroove), and TSVT (MTX surface, fully textured with microgroove) were similar to that on the machined surface.

All the roughened surfaces with Sa > 1um exhibited significantly increased bacterial attachment when compared to the machined surface.
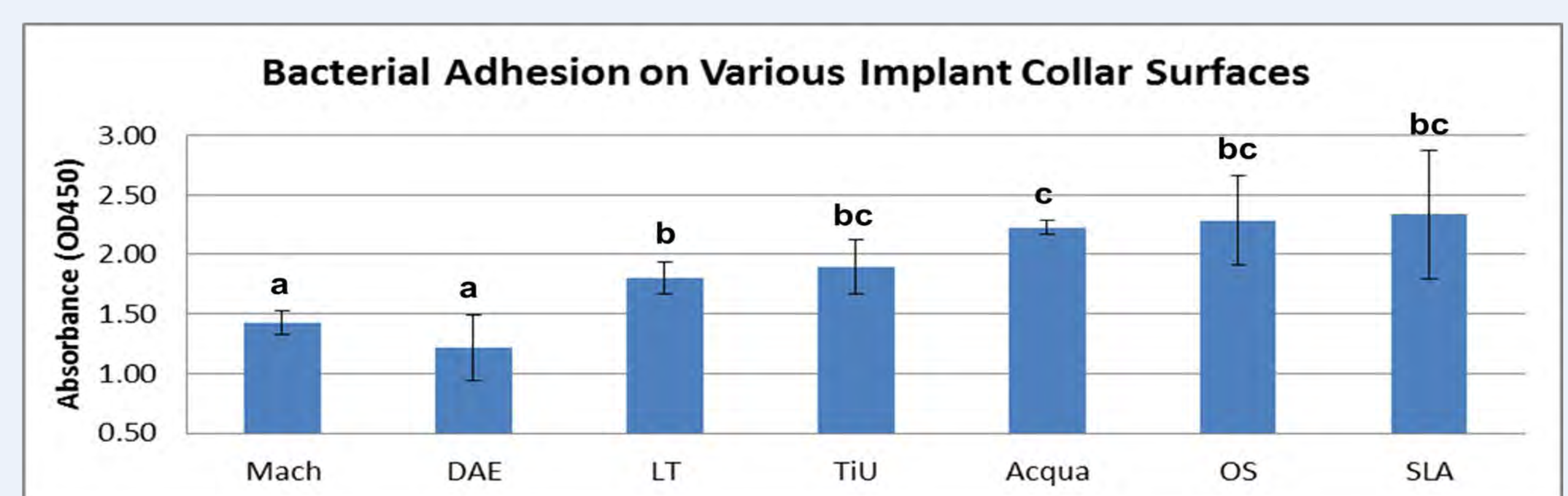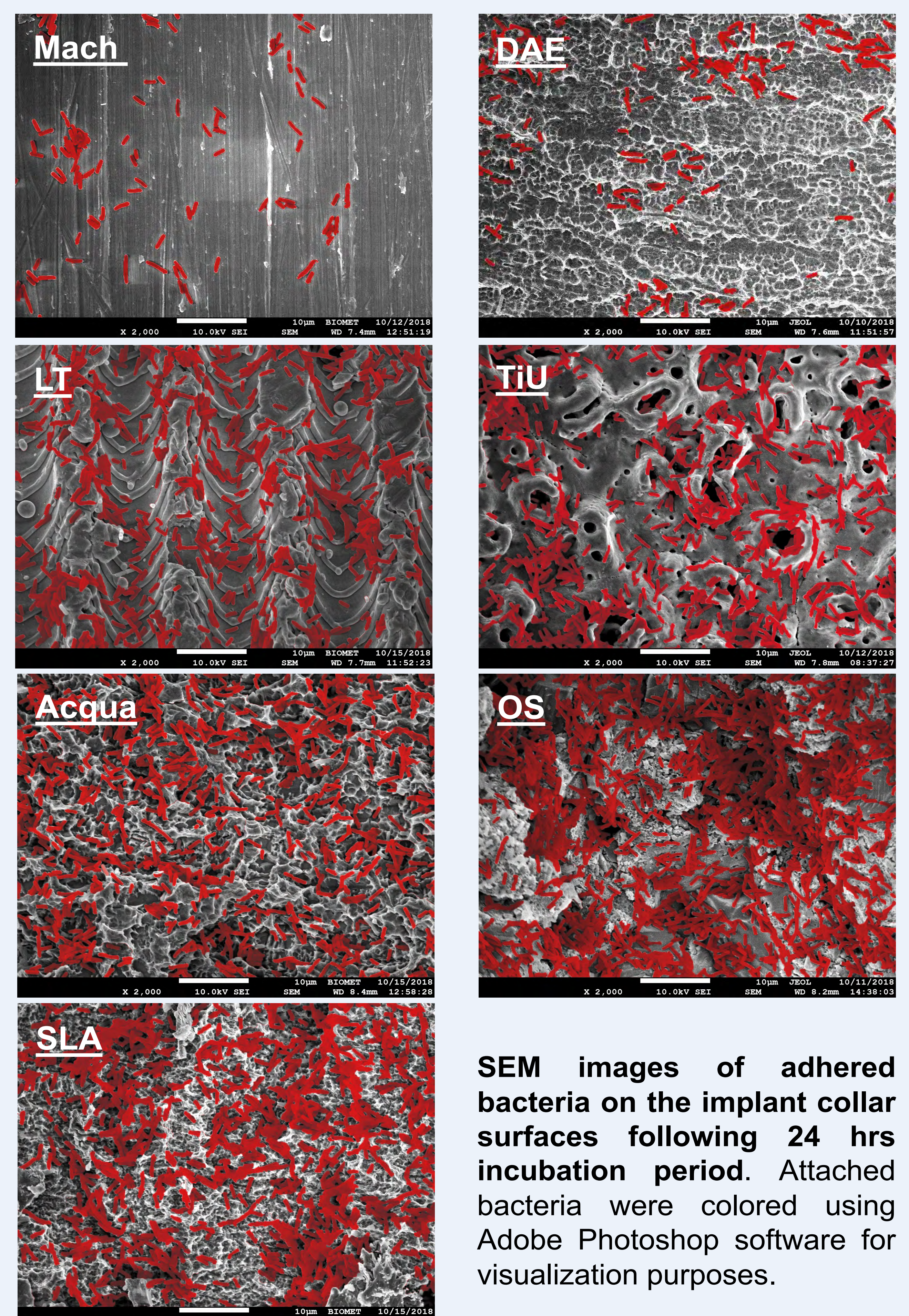

Figure 3: Surfaces with Sa > 1um showed significantly increased bacterial adhesion. No significant differences were seen between the DAE and Machined surfaces. Means that do not share a character are statistically significant.

SEM images of adhered bacteria on the implant collar surfaces following 24 hrs incubation period. Attached bacteria were colored using Adobe Photoshop software for visualization purposes.

Figure 4: SEM analysis confirmed that rougher surfaces exhibit more bacterial aggregations.