# Three dimensional assessment of crestal bone levels at titanium implants with different abutment microstructures and insertion depths using µCT

K. Becker[1,2], Inka Klitzsch[2], Martin Stauber[3], Frank Schwarz[2]
[1]Department of Orthodontics, University Clinic Düsseldorf, Germany
[2]Department of Oral Surgery, University Clinic Düsseldorf, Germany
[3]Scanco Medical AG, Brüttisellen, Switzerland

HEINRICH HEINE UNIVERSITÄT DÜSSELDORF

## Background

Previous research evaluated the impact of insertion depths and abutment topology at few histological sections or 2D X-rays. It is not clear how well these measurements correspond to the 3D dehiscence profile.

## Aims

The aims of this study were to assess (i) the impact of insertion depth and abutment micro-structure on the three-dimensional crestal bone level changes at endosseous titanium implants using µCT and computerized image processing, and (ii) to assess agreement with previously reported histology.

## Material and Methods

### 1.) Surgery

Titanium implants (Camlog Screwline) were inserted in each hemi-mandible of six foxhounds with the implant shoulder (IS) located either in epicrestal (0 mm), supracrestal (1 mm), or subcrestal (-1 mm) positions and connected with with micro-grooved (G) or machined (M) titanium healing abutments (split mouth design).The animals were euthanised after 20 weeks of healing, and biopsies were harvested and embedded in PMMA.

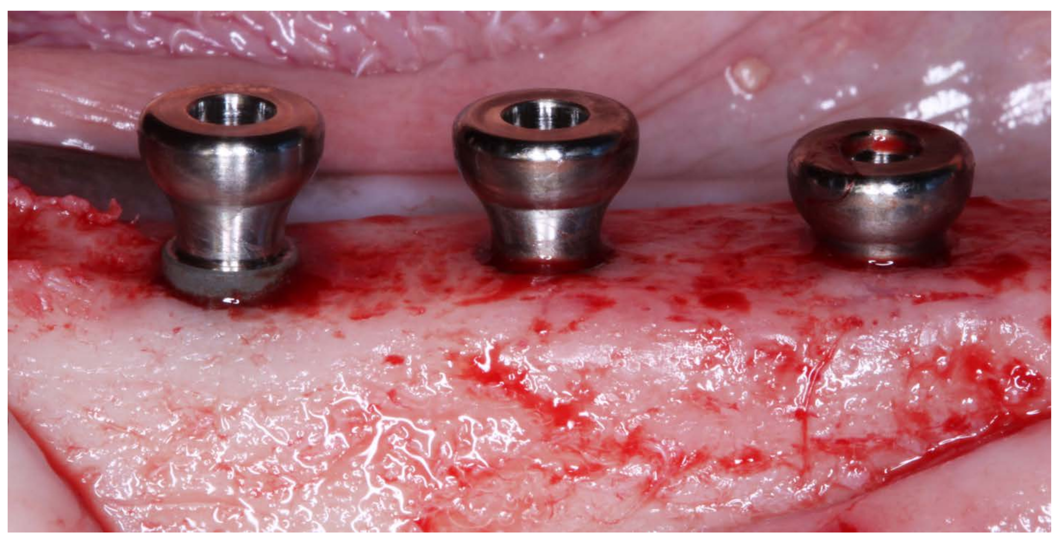
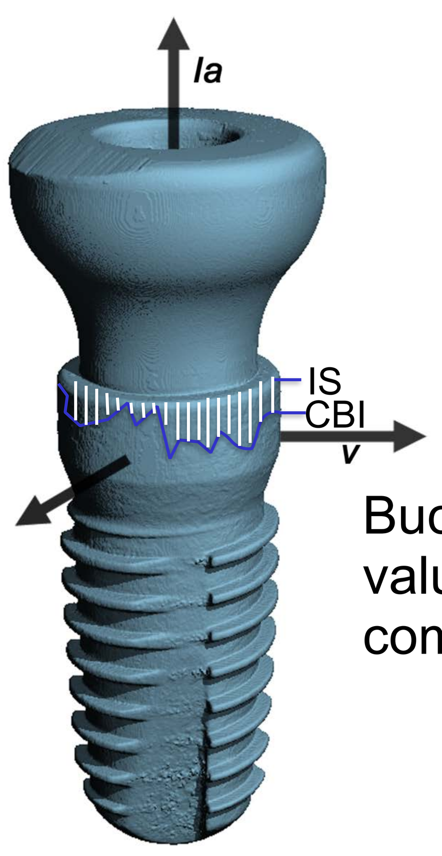


**Figure 1:** Implant placement in supracrestal, epicrestal. or subcrestal positions.

### 2.) µCT Scanning and Histology

The PMMA-embedded biopsies were scanned with a µCT 50 (Scanco Medical AG) and the volumetric dehiscence profiles around the implants were calculated as distance between IS and the most coronal bone to implant contact (CBI). This was performed in 5 degree steps around the implant axis. After µCT scanning, ground sections were prepared in buccal-oral direction. Then, CBI-IS distances were measured and compared with the averaged buccal and oral values from µCT.

72 "virtual 2D slides" computed to measure IS-CBI distances by rotating v in 5° steps around $I_A$.




Buccal and oral IS-CBI values were averaged for comparison with histology.

**Figure 2:** Dental implant visualising the 72 positions at which IS-CBI values were measured.

## Results

### 1.) 3D evaluation of IS-CBI values

A median net bone gain was observed for supracrestal insertion depths at both abutment types, but lower bounds of the 75% quartile experienced net bone losses. Epicrestal and subcrestal insertion depths were linked to slight bone losses, and the buccal and oral dehiscences were smaller compared to supracrestal positioning.

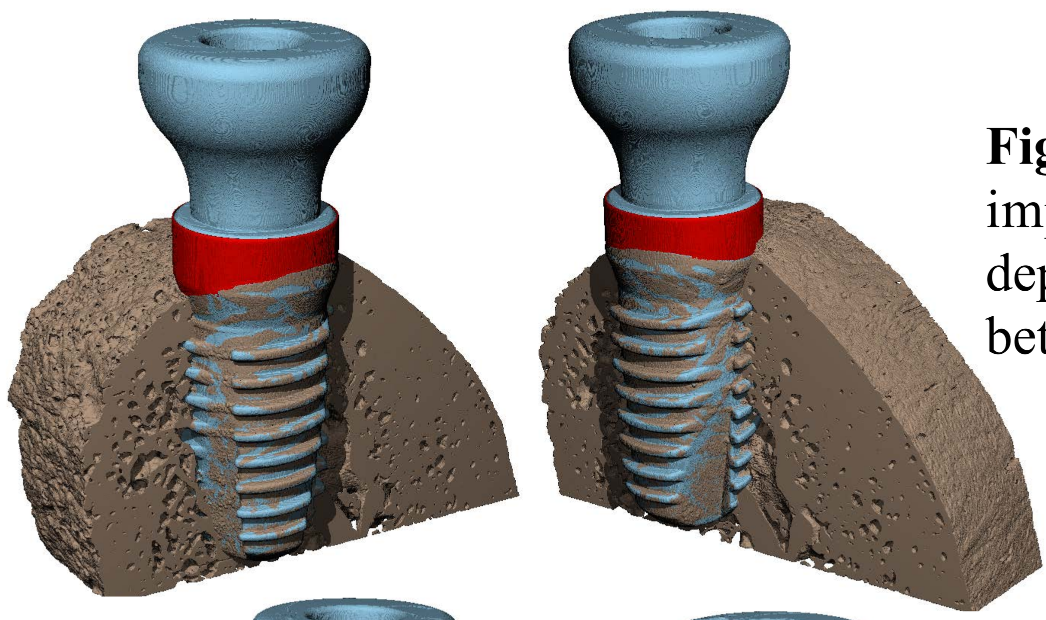


**Figure 3:** Buccal and oral views of an implant with supra-crestal insertion depth. The red area represents the area between IS and CBI.

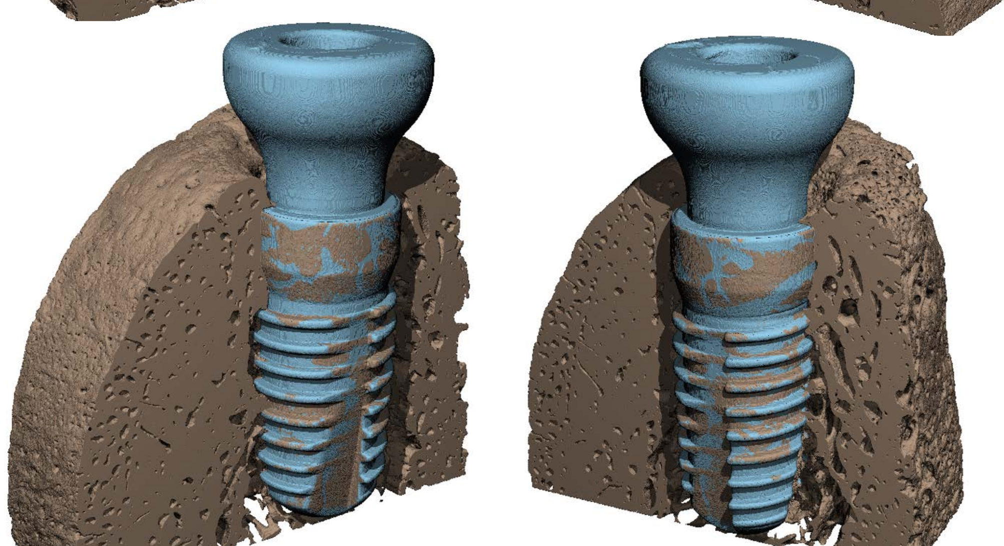


**Figure 4:** Buccal and oral views of an implant with sub-crestal insertion depth. The red area represents the area between IS and CBI.

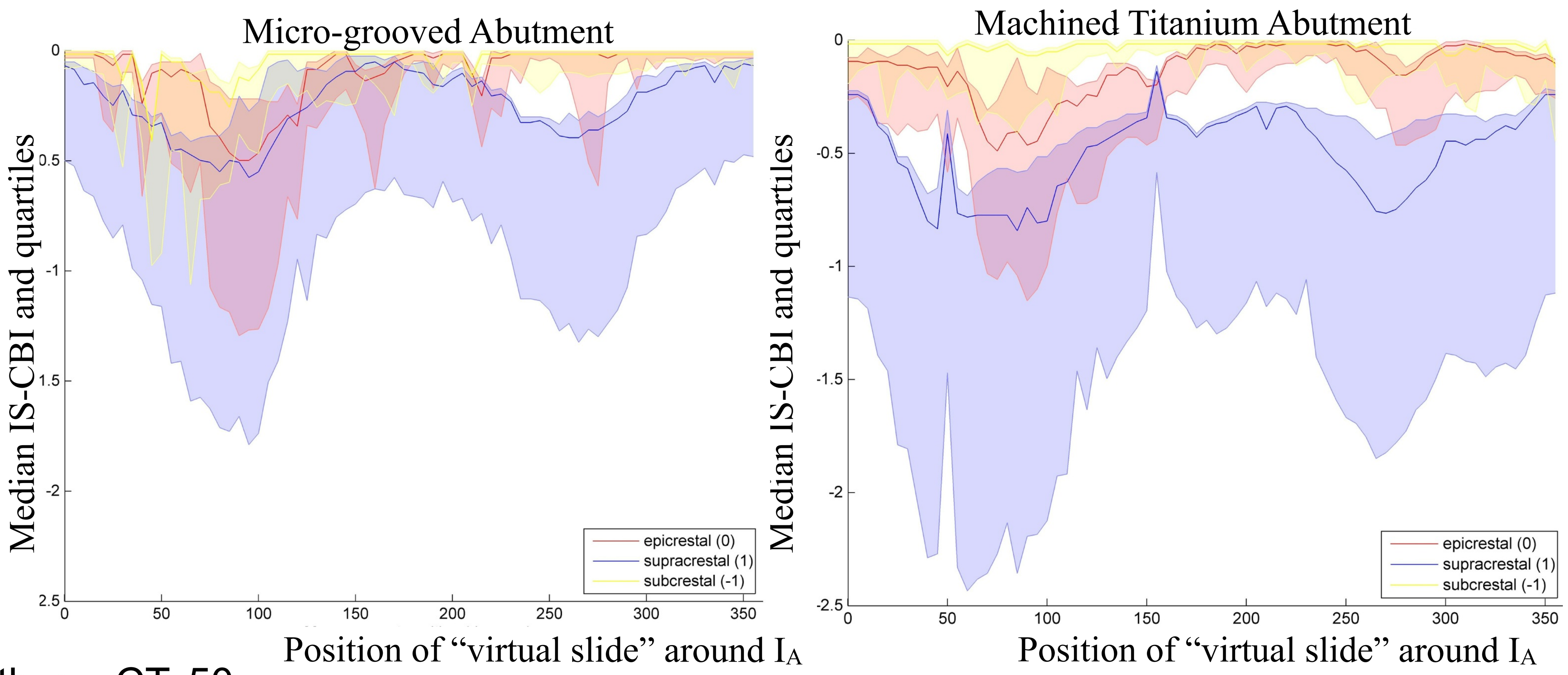
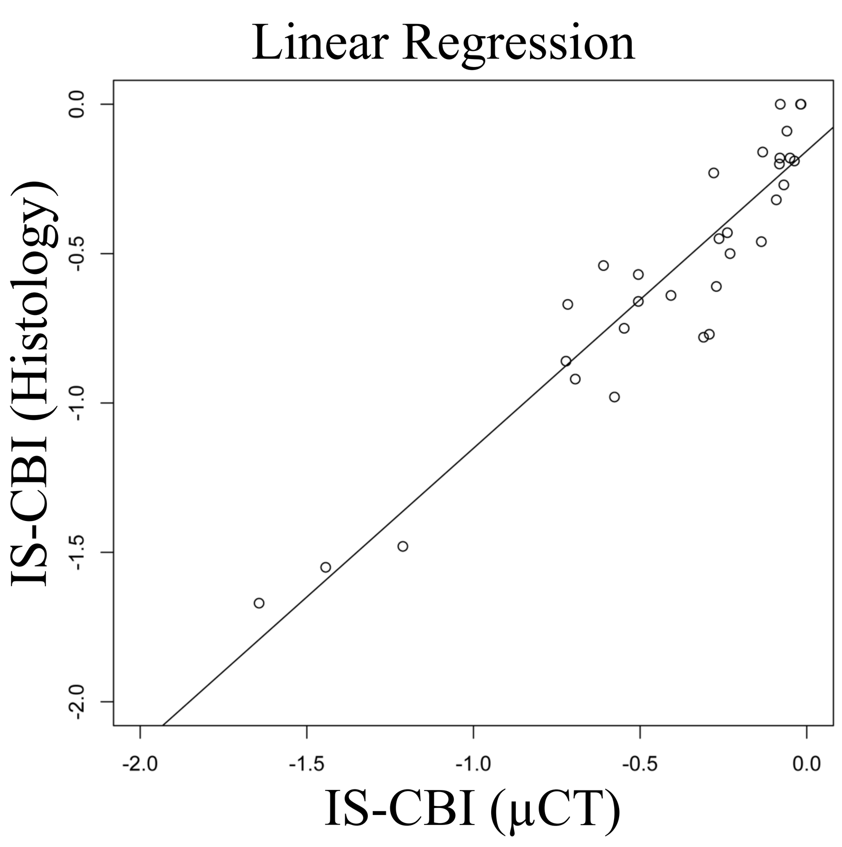



**Figure 5:** Median IS-CBI values and quartile ranges for the two abutments and thee insertion depths.

### 2.) Comparison µCT with HI




A moderate agreement between averaged µCT and HI IS-CBI values (oral: $R^2=0.58$, buccal: $R^2=0.88$, $p<0.001$) was found.

## Conclusions

The novel image processing method points at a direct impact of insertion depths on crestal bone level changes, and also indicates that HI assessments crucially depend on the chosen cutting position.