

Torque fracture testing of autologous and autogenous bone block fixating mini-screws

Réka Stefanics¹, Roland Told², József Szalma PhD, DSc³

University of Pecs, Department of Oral and Maxillofacial Surgery

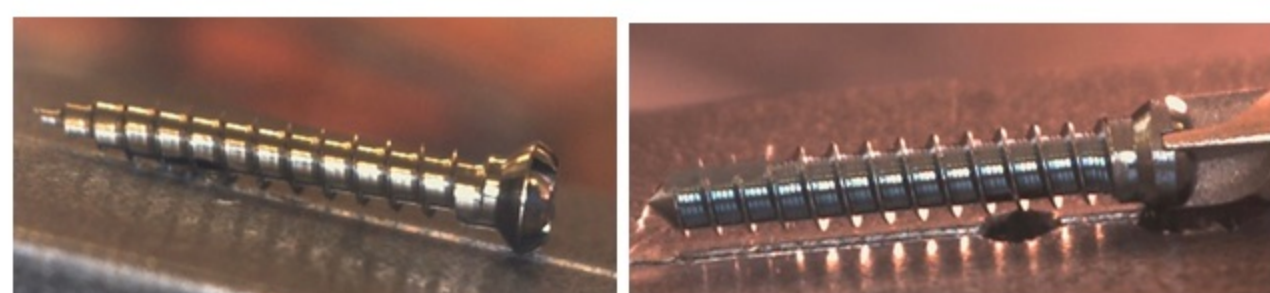
Introduction

Mini- and micro-screws are used in maxillofacial osteosynthesis, for orthodontic skeletal anchorage or in bone augmentation procedures of the jaws. Several screw types of different manufacturers are available; however, our selection should be based on knowing the exact mechanical properties.

Torque fracture of included screws were tested to investigate *ultimate tensile strength* (UTS), *yield strength* (YS) and *exact angle of UTS* (UTS-A).

Materials and methods

Promed 2000, Hager&Meisinger and DePuy Synthes screws between the diameter of 1.0-2.0 mm were involved. UTS, YS and UTS-A was examined with Zwick/Roell Z5.0 biaxial testing apparatus, while macroscopic appearance of screws during testing was recorded by a video-microscope. For comparing screws' data, independent samples T-test and ANOVA followed by Tukey HSD post-hoc tests were used.

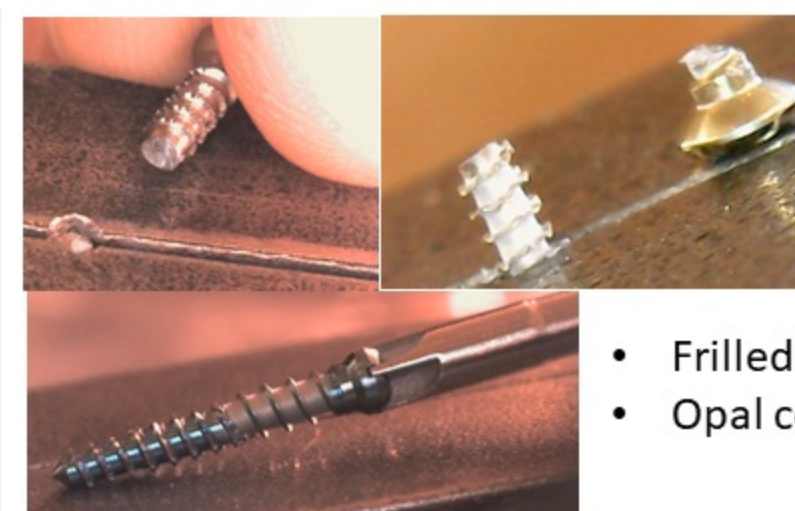


Promed Ti	Ø1,0 (0,7) mm	Ø1,6 (1,1) mm	Ø1,8 (1,3) mm	Ø2,0 (1,5) mm
Promed TiAl ₆ V ₄	Ø1,6 (1,2) mm	Ø2,0 (1,5) mm		
Meisinger -	Ø1,0 (0,7) mm	Ø1,3 (0,95) mm		
DePuy Synthes TiAl ₆ Nb ₇	Ø1,3 (1,0) mm	Ø1,5 (1,3) mm		

TABLE 1. Included screws.

Results

-Visual changes

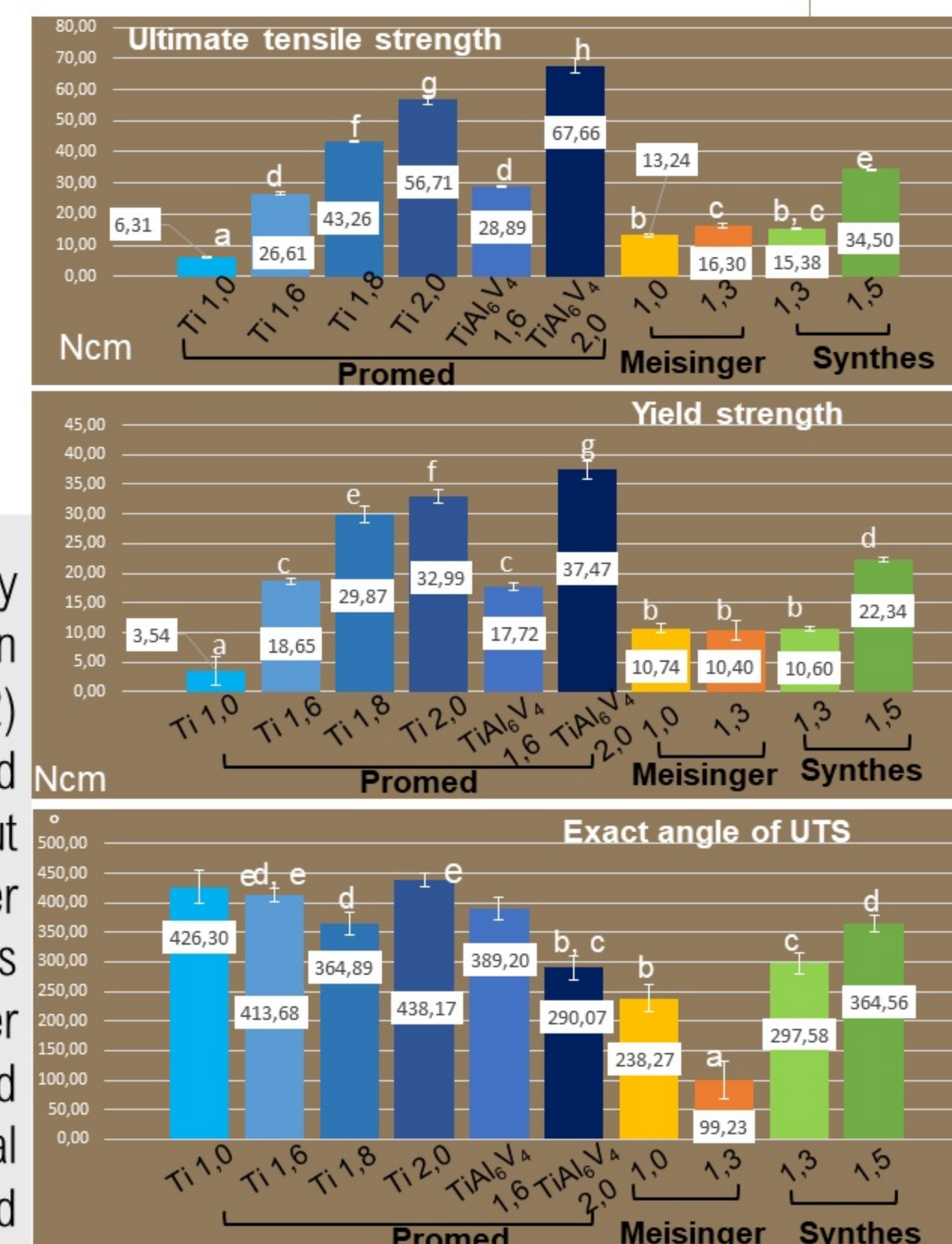


- Frilled threads
- Opal color change

FIGURE 2. Visual changes before fractures.

Meisinger 1.0mm screw produced significantly higher UTS and YS, but lower UTS-A than Promed Ti 1.0mm ($p < 0.001$). UTS ($p = 0.092$) and YS ($p = 0.858$) of Synthes 1.3mm and Meisinger 1.3mm screws were similar, but UTS-A value of Synthes 1.3mm was higher ($p = 0.001$). UTS and YS of Synthes 1.5mm was the highest among 1.5-1.6mm in diameter screws, however the Promed 1.6mm screw had the highest UTS-A ($364.6^\circ \pm 12.9^\circ$). In the total comparison, Promed TiAl₆V₄ 2.0mm showed the highest UTS (67.6 ± 2.3 Ncm) and YS (37.5 ± 1.5 Ncm), while Promed Ti 1.0mm the lowest (6.3 ± 0.3 and 3.5 ± 2.4 Ncm) values. Right before screw fractures, the most characteristic macroscopic sign were an opal color change and frilled change in appearance of the threads.

-Fracture tests



Conclusion

For safe intraoperative applications, oral surgeon should exactly know the limit of elastic deformations and torque fracture values of the selected screws.

FIGURE 1. Use of mini-screws.