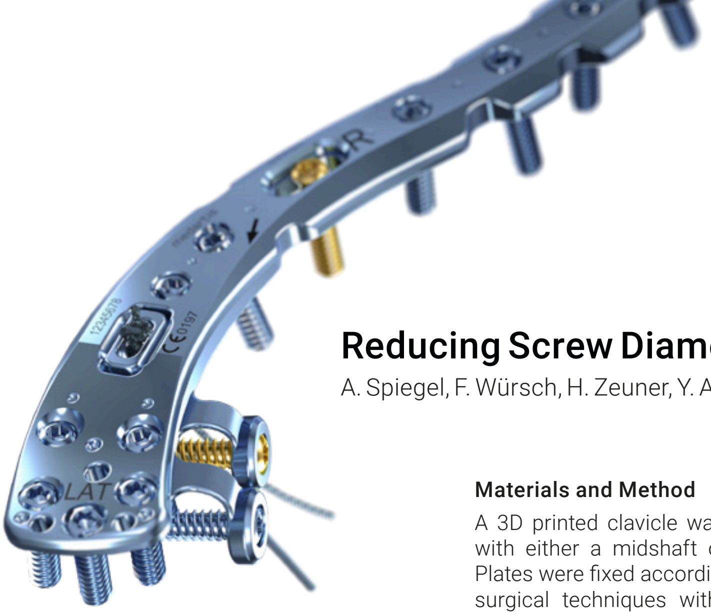

medartis

PRECISION IN FIXATION

Reducing Screw Diameter in Clavicle Fixation – 2.8 versus 3.5

A. Spiegel, F. Würsch, H. Zeuner, Y. Andrée, C. Steiger, Medartis AG, Switzerland

Introduction

Clavicle fractures are fairly common – accounting for about 5 percent of all fractures in adults. Most fractures occur in the middle portion, or shaft, of the bone and can be treated conservatively in most cases. However, surgery may be indicated for more complex fractures. More recent studies show higher rates of non-union and poorer functional outcomes after non-operative treatment, whereas results of ORIF have improved[1].

The versatile Medartis APTUS Clavicle System 2.8 includes superior midshaft, superior lateral shaft, and superior lateral plates including an option to fix sutures to the plate, as well as anterior midshaft and anterior lateral plates. The special design of the superior lateral plates offers two flaps for additional screw fixation from anterior to posterior to increase stability.

Medartis has developed a 2.8 system which gives surgeons the option to use narrow and low profile plates with multidirectional locking screws in a small diameter. The smaller screw diameter compared to other systems in the market raises questions on the mechanical stability of the Medartis 2.8 system.

A test was designed that compares different plates that use either Ø 2.8 mm or Ø 3.5 mm screws for different fractures. The goal of the test is to answer the question whether 3.5 screws are strictly needed to ensure sufficient stability.

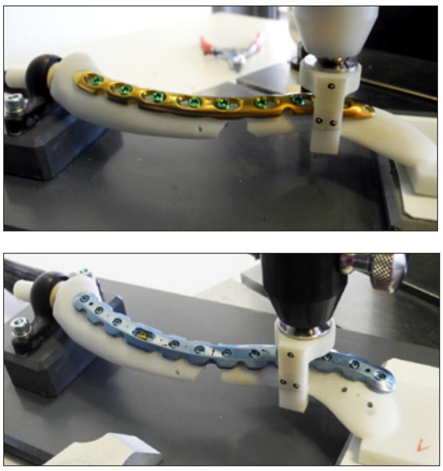

Fig. 1: Setup for superior midshaft plate, shown with competitor plate (top) and Medartis plate (bottom)

Materials and Method

A 3D printed clavicle was used as substrate with either a midshaft or a lateral fracture. Plates were fixed according to their respective surgical techniques with locking screws in all locking holes and cortical screws in the remaining ones. Load was introduced slightly lateral to the clavicle center using a universal testing machine. Fatigue loads were applied using a sinusoidal loading pattern and load was increased until fracturing according to a staircase loading regime (load increase every 10'000 load cycles).

Three different plates were tested with the corresponding defects:

- A comminuted midshaft fracture with dorsal cortical contact was bridged once with a superior midshaft plate (figure 1) and once with an anterior midshaft clavicle plate.
- A lateral three part fracture with bony contact was fixed with a superior lateral plate (figure 2).

Medartis APTUS 2.8 TriLock Clavicle Plates were compared to plates from a leading competitor using 3.5 locking screws. Failure load and fatigue life were recorded and compared. 6 plates were tested each.

Results

Failure loads for different applications are shown in figure 3 as box plots.

- **Superior Lateral and Anterior Plates**

  Medartis and competitor constructs perform equally well and both fail through screw fracture. Overall strength is the same independently of whether 3.5 or 2.8 screws were used.

Fig. 2: Superior lateral plate setup, fracture line shown in red

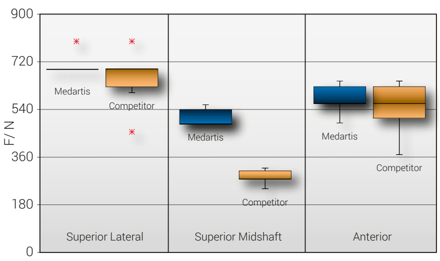

Fig. 3: Failure loads of the three plate constructs (red asterisks designate outliers)

- **Superior Midshaft Clavicle Plates**

  The Medartis 2.8 construct is significantly stronger than the competitor construct with 3.5 screws. The competitor construct fails relatively early (loads <300N) while the Medartis system withstands more than 500N. Again, smaller screws prove to be more than adequate for the load case and failure is a function of the system. Figure 4 shows typical failure patterns for both Medartis and competitor constructs. Both Medartis and competitor constructs failed either at the screw or at the plate level regardless of the screw diameter used.

Conclusion

The results demonstrate that construct strength is not simply a function of the screws used but of the interaction between plate, screw and substrate. Larger screw diameters do not necessarily result in a stronger system and vice versa.

Considering that 2.8 screws require smaller holes, it further seems likely that periprosthetic fractures or fractures after plate removal may be reduced. Clinical studies are needed to further evaluate this possible advantage of smaller screw diameters.

Bibliography

1 L.A. Kashif Khan, Timothy J. Bradnock, Caroline Scott and C. Michael Robinson J Bone Joint Surg Am. 2009; 91:447-460

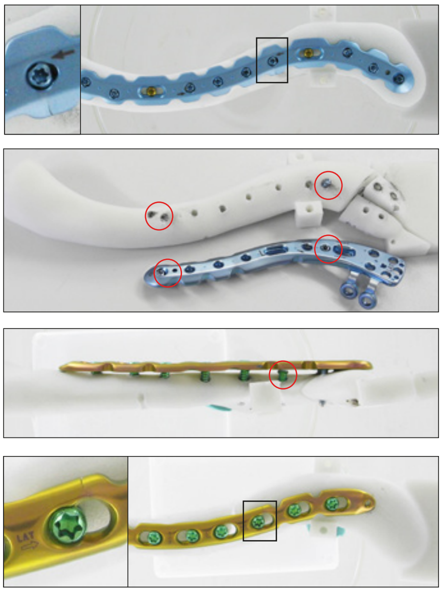

Fig. 4: Medartis (blue) and competitor (gold) constructs that failed either at the plate or at the screw level; failure locations are circled in red, enlarged images show details

Medartis AG
Hochbergerstrasse 60E | 4057 Basel / Switzerland
P +41 61 633 34 34 | F +41 61 633 34 00
www.medartis.com