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PRECISION IN FIXATION

Comparing Medartis APTUS 2.5/2.8 TriLock Plates vs 3.5 mm One-Third Tubular Plates

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Introduction

Ankle fractures are one of the most common injuries requiring surgical treatment and account for about 9 % of all fractures.

Simple lateral malleolar fractures have historically been treated using one-third tubular plates either laterally as neutralization plates or posterior laterally as antiglide plates with inter-fragmentary lag screws.

Medartis has developed two types of 2.8 TriLock Distal Fibula plates which now give surgeons the option to use narrow low profile multidirectional plates to repair distal fibula fractures as opposed to the traditional one-third tubular plates.

The plates have the added advantage of having a reconstruction design with staggered screw geometry, reducing screw collision or splitting of the bone as well as a 3 screw fixation option in the head providing extra fixation when needed distally in osteoporotic bone.

Materials and Method

Medartis has two plate designs that have the same intended use as the commonly used 3.5 mm one-third tubular plate namely the APTUS 2.5 TriLock Plates, Y, and the APTUS 2.8 TriLock Fibula plates.

The plates in the test were compared in a fatigue test that simulates axial loading in a closing wedge setup; this loading scenario would typically appear after a fibula fracture. The Medartis plate (APTUS 2.5 TriLock Plate 2/5 Hole Y, t1.6, A-4750.91) with 2.5 mm TriLock locking screws and a thickness of 1.6 mm was identified as the worst case compared to a one-third tubular plate that uses 3.5 mm fixed locking screws (see **Figure 1**) and hence used for testing.

A 3D printed fixture that simulates a long bone with a cortical outer layer and a cancellous core (**Figure 4**, left) was used to recreate an anatomical situation that corresponds to an AO 42 A3 fracture. Plates were sinusoidally loaded in the longitudinal axis at 4 Hz using a staircase approach (load increase after a defined number of cycles) until plate or screw fracture.

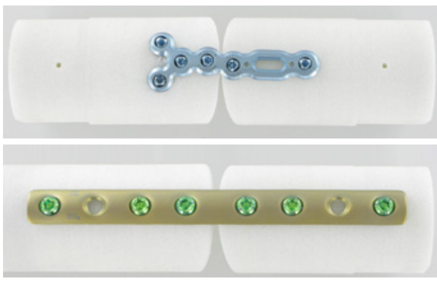

Fig. 1: Medartis APTUS 2.5 TriLock plate (top) and one third tubular plate (bottom) before testing

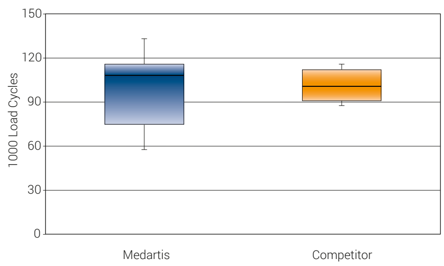

Fig. 3: Fatigue Life of Medartis APTUS 2.5 TriLock plate (left) and one third tubular plate (right)

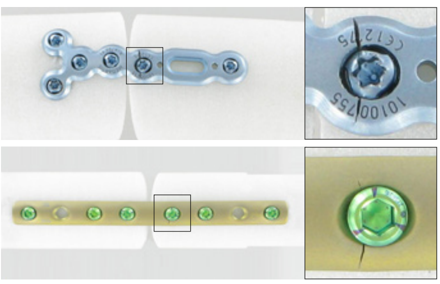

Fig. 2: Medartis APTUS 2.5 TriLock plate (top) and one-third tubular plate (bottom) after testing; the insert shows a magnification of the fracture zone.

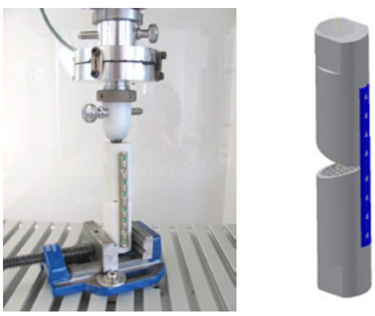

Fig. 4: Test setup showing loading (left) and the trabecular structure of the 3D printed fixtures.

Results

Figure 3 gives an overview over the average fatigue strength of the two plates. As can be seen, the Medartis plate has a performance comparable to the one-third tubular plate even though it uses much smaller (and therefore weaker) 2.5 mm screws. This can be explained when looking at the failure mode in **Figure 2** which shows broken specimens. All constructs failed at the plate and not at the screw level. Since larger holes are needed for the 3.5 mm screw's voluminous head, the plate has a fatigue strength comparable to the seemingly more delicate Medartis plate.

Conclusion

It has been customary to use one-third tubular locking plates with 3.5 mm screws for fibula fractures while plates with smaller screws have been considered too weak. This test demonstrates that the fatigue strength of a construct will depend on the weakest link. Strong screws will not improve overall strength if the plate is the weakest part. As the fatigue performance of the Medartis plate is comparable to the one-third tubular plate, the screw diameter is not the relevant factor. It can be concluded that as the 2.5 mm and 2.8 mm Medartis plates have the same plate thickness they are both comparable in fatigue performance to the one-third tubular plate.

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