# Locking plates – The ultimate implant?

## *"Nothing holds up the progress of science so much as the right idea at the wrong time."* Vincent de Vigneaud, Canada (1978)

Editorial

Bone plating has been the gold standard as a method for treatment of fractures in adult animals for many years. Since the early days of pioneer surgeons such as the Lambotte brothers from Belgium, Lane from London, Hey-Groves from Bristol, and Sherman from USA, numerous different types and styles of bone plates have been introduced. With time and clinical experience, many of these implants have fallen by the wayside and can now be found collecting dust in the back of hospital storage cupboards. However, if we had to nominate one plate that has survived to become an orthopaedics icon, then by various measures it would clearly be the dynamic compression plate (DCP) developed by the AO in Switzerland. Just the very name of this implant implies some vigorous and energetic attributes; indeed for several decades an important principle of shaft fracture treatment was the attainment of interfragmentary compression and primary bone healing without radiographically evident callus formation. The design of the DCP implant has been subtly imitated, blatantly plagiarized and thoughtfully modified by both the leaders and the followers of bone plate development. If it is true that imitation is the highest form of praise and recognition, then the concept of the DCP was truly a milestone in orthopaedics. The most unique feature of this implant is the precisely engineered internal glide pathway found in each hole of the plate; it allows the generation of interfragmentary compression with insertion of a load screw. Much of the research that went into optimizing the dimensions, slope and geometry of this special plate hole never surfaced in refereed publications; the fact that it works is now taken for granted.

When a conventional plate is fixed to bone, tightening of the bone screws compresses the plate to the bone. For the stability of the fixation to be maintained, then friction between the screw head and the plate, as well as between the plate and the underlying bone, must be maintained. Although the generation of compression between the fractured bone fragments is sometimes possible with simple reducible fractures, the need for compression of the plate to the underlying bone is mandatory in all cases. Perhaps the biggest problems with conventional plates are the absolute requirement for accurate contouring of the plate to the surface of the underlying bone, and the need to compress the plate to bone. The effect of compressing the plate to the bone, and its putative deleterious effects upon bone vascularity and viability became a contentious issue, and was the impetus to reduce the amount of plate contact with the underlying bone. This led to the development of the limited contact DCP. However, this modified implant design still did not negate the need for accurate plate contouring.

It has long been assumed that the bending and twisting required to contour a bone plate does not significantly compromise its material properties in a clinical situation. However, an in-vitro mechanical study reported in this issue of the Journal found that the bending and twisting of plates results in a significant loss of plate stiffness (1). To ascertain whether or not this loss is clinically significant will require some further investigation. Furthermore, another study found that omission of selected screws from buttress plates affected plate strain at some distance from a simulated fracture gap, and influenced the cyclic fatigue life of constructs (2). This information is relevant to the recently introduced technique of minimally invasive percutaneous osteosynthesis of comminuted shaft fractures, in which long plates are applied in submuscular tunnels with minimal screw fixation.

In my opinion the introduction of angle stable screws for bone plate fixation has been the most important and exciting new

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development in bone plate design since the advent of the DCP. The evolution of locking plates with angle stable screws can be traced back some decades to the Zespol plate from Poland (3). Angular stability of the bone fixation screws with respect to the Zespol plate was achieved with use of lock nuts. However, a more elegant solution to angular stability was use of the Morse cone at the screw head/plate hole interface, in the point contact fixator (PC-Fix) (4). Perhaps the PC Fix was too far ahead of its time, but for various reasons it was never commercialized, although two currently available locking plates have their origins in the PC Fix. A different approach to screw locking was taken by Brunnberg with the no contact plate (NCP) (5). Screws used in the NCP had uniformly threaded, cylindrical heads to engage the threaded, round plate holes (5). More recently, the locking head screws designed for use with the locking compression plate (LCP) featured a combination of the Morse cone with double lead threads. Accurate engagement of the double lead threads into the LCP are critical for angular stability, but a major advantage of all locking plates is that accurate plate contouring is unnecessary for clinical usage (6, 7). Several other locking plate systems have been recently developed for the veterinary market. The string of pearls (SOP) plate apparently works by engagement of the final turn of screw shaft thread with the plate hole (1). In this way, the head of the screw is lagged within the plate hole. Similarly the advanced locking plate system (ALPS) also relies on engagement of the screw shaft threads with the plate hole, although the head of the screw is also a Morse cone like the old PC Fix. A novel application of the ALPS for tarsometatarsal arthrodesis in a cat is reported in this issue of *VCOT* (8). Each of the currently available locking plate systems apparently has various advantages in terms of cost, versatility and simplicity of application. However, 'the jury is still out' on locking plates, until we have seen more long term results of their clinical use in animals.

## References

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