Which drill is best for ankle fracture fixation?

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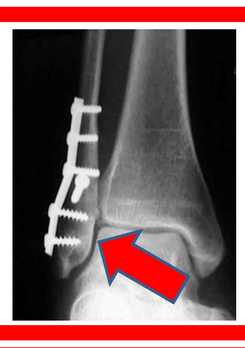
THE PROBLEM

1. **Soft Cancellous Bone Distally**
2. **Unicortical Fixation Distally**



HOW DO *YOU* DRILL THE *DISTAL* SCREW HOLES?

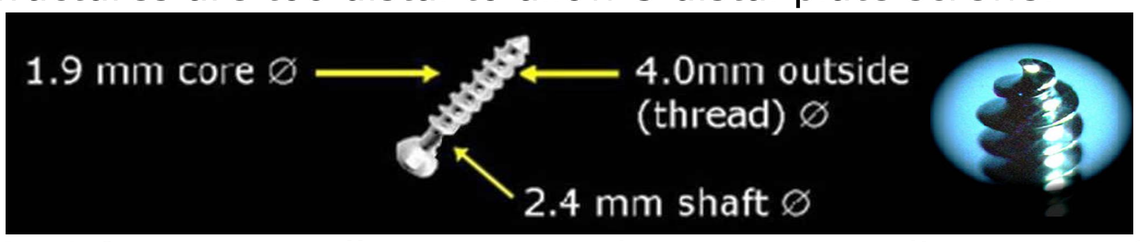
2.5mm drill
OR
2.0mm drill
OR
2.0mm K-wire

Background

The senior author routinely uses a **2.0mm K-wire** to prepare the hole for the distal cancellous screws and does not tap the pilot hole. We wanted to determine whether this would improve the fixation.

Ankle fracture (Lateral Malleolus) fixation is a common orthopaedic procedure. Many surgeons complain that the screw purchase in the distal fibula is often weak. The metaphyseal bone in this area typically has poor bone quality.

The advice of the AO Foundation is to use a 2.5mm drill bit to create a pilot hole for a 3.5mm cortical screw and to tap the outer cortex. In the case of osteopaenic bone, AO recommends substituting cortical screws for 4.0mm cancellous screws. They also recognise that many fractures are too distal to allow 3 distal plate screws.



A 4.0mm cancellous screw has a core diameter of 1.9mm and a shaft diameter of 2.4mm.

Fully threaded cancellous screws are used for distal lateral malleolus fractures. The 2.4mm shaft section is very short and lies within the plate, so it does not enter the bone. Thus, the 2.0mm pilot hole can accommodate the 1.9mm core diameter of the screw.

Cancellous screws create their own thread by impacting bone aside, in a similar manner to a snow plough making a path through the snow. The tip design achieves this as the spiral of the helix increases from a point at the tip, to the full thread diameter over two turns. In soft bone a tap is therefore not needed.

Method

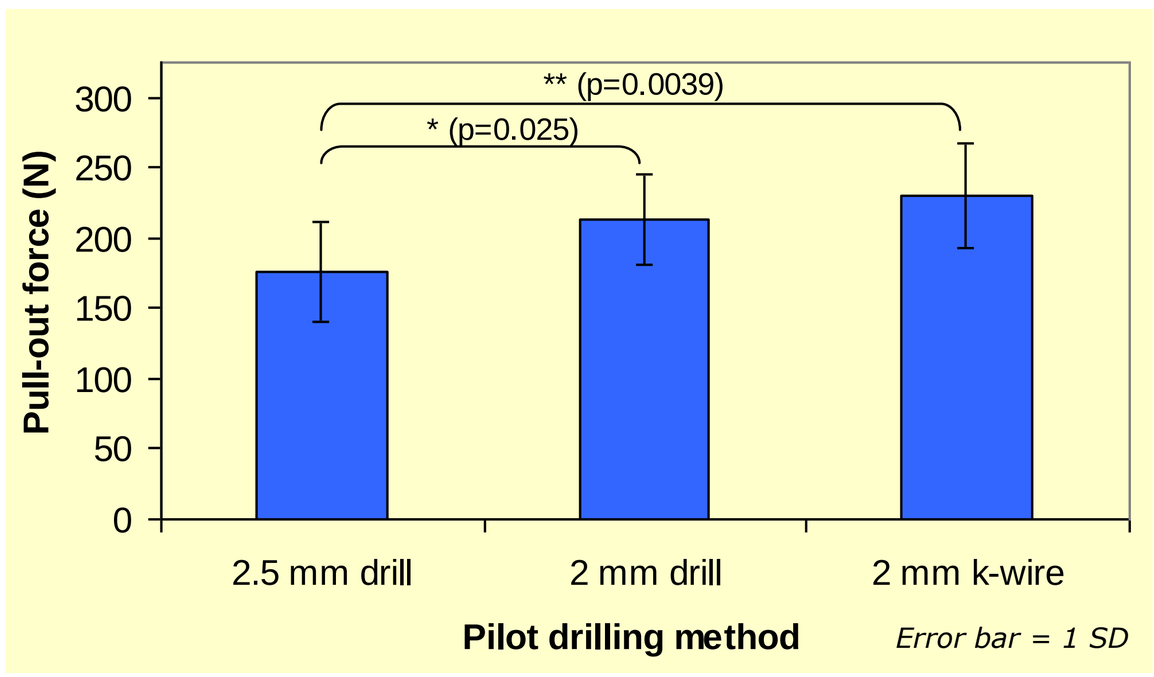
To test the hypothesis that a smaller pilot hole would increase the pullout strength, we created 3 cohorts of 10 screws. Each cohort had a pilot hole drilled with either a 2.5mm drill, a 2.0mm drill or a 2.0mm K-wire.

We used Synbone 'Osteoporotic Generic Bone 0081', to simulate osteoporotic cancellous bone. It is a specially formulated polyurethane foam comprising of a cancellous inner core and a harder outer shell simulating cortical bone. It does not replicate the exact biomechanical properties of human bone but does provide a consistent test medium for testing medical bone screws.

The Synbone is 170mm long with a diameter of 25mm. The screws were inserted at 40mm, 70mm, 100mm and 130mm, to a depth of 20mm as specified in ASTM 1691. The Synbone was mounted in the testing machine (ESH, Brierley Hill, West Midlands) and held with clamps 20mm at either end.

Axial load was applied to the screw at a rate of 5mm/min until the screw failed (ASTM 1691). The maximum load before failure was taken as the pullout strength. The mean and standard deviations were calculated. The results were statistically analysed with an unpaired t-test, followed by Holm's procedure. An overall p-value <0.05 was assumed to denote statistical significance.

Results



Drilling method	Pullout strength (N; SD)		
2.5mm drill	176.5 (35.6)	p=0.025	p=0.0039
2.0mm drill	213.6 (31.9)	p=0.30	
2.0mm K-wire	230.0 (36.7)		

Discussion

The results demonstrate that the pullout strength of a 4.0mm cancellous bone screw is significantly increased with a pilot hole of 2.0mm drilled with a K-wire or drill, compared to a 2.5mm pilot hole, as recommended by the AO Foundation.

A 2.0mm pilot hole increases the pullout strength by 21% with a drill (p=0.025) and 29% with a K-wire (p=0.0039). Although the differences between a 2.0mm drill and K-wire were small, a K-wire is superior to a 2.0mm drill because it does not remove bone but compacts it. This enhances the effects of the cancellous bone screw thread design.

These results are important because a surgeon with improved confidence in their distal fixation is more likely to commence early weight bearing.

In osteopaenic / osteoporotic bone, we recommend the use of a 2.0mm K-wire to drill the distal fibula pilot holes for a 4.0mm fully threaded cancellous screw. These are readily available in all operating departments.