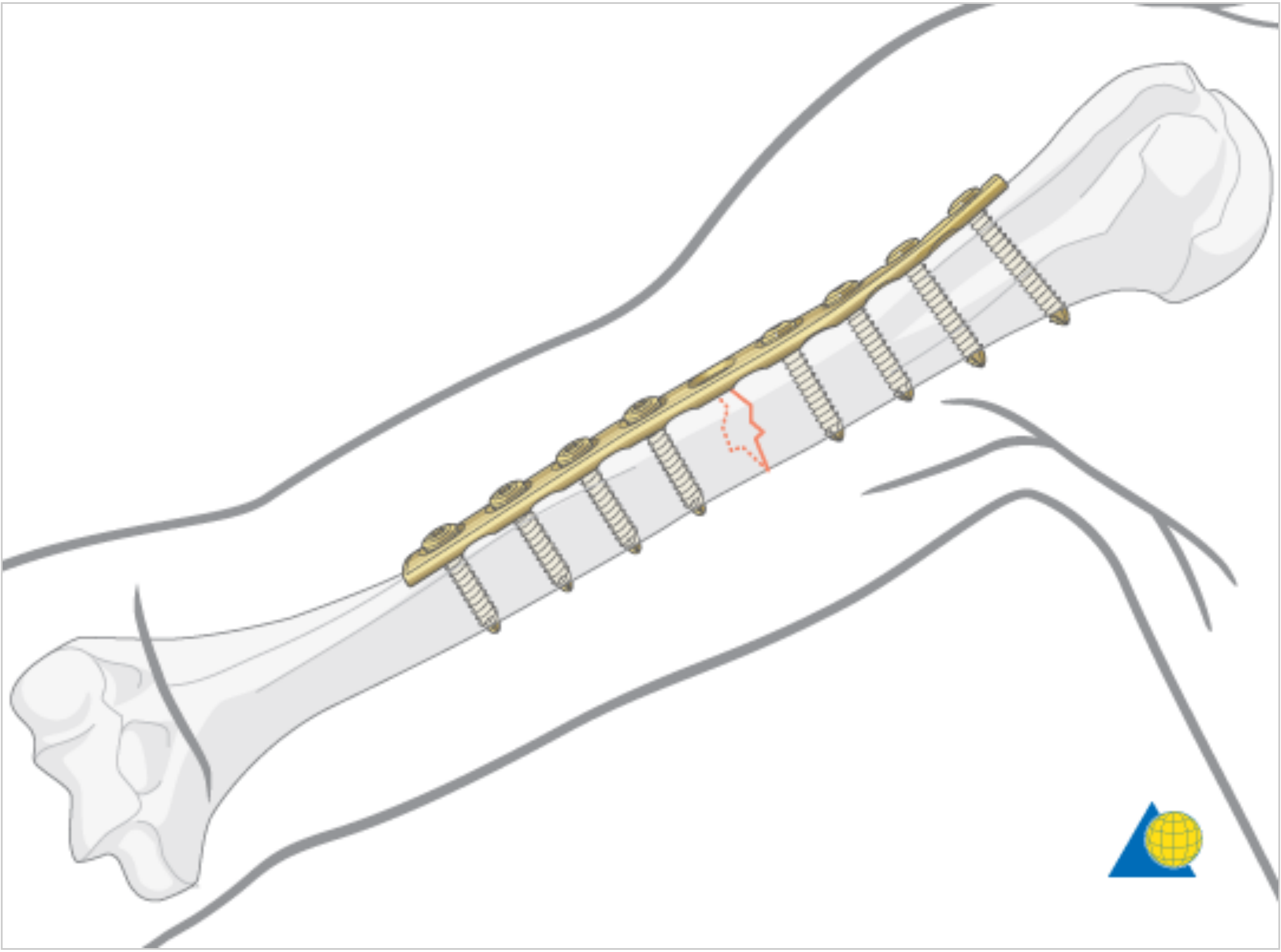
Humerus shaft 12-A3 ORIF

Authors

Compression plating

1. Principles

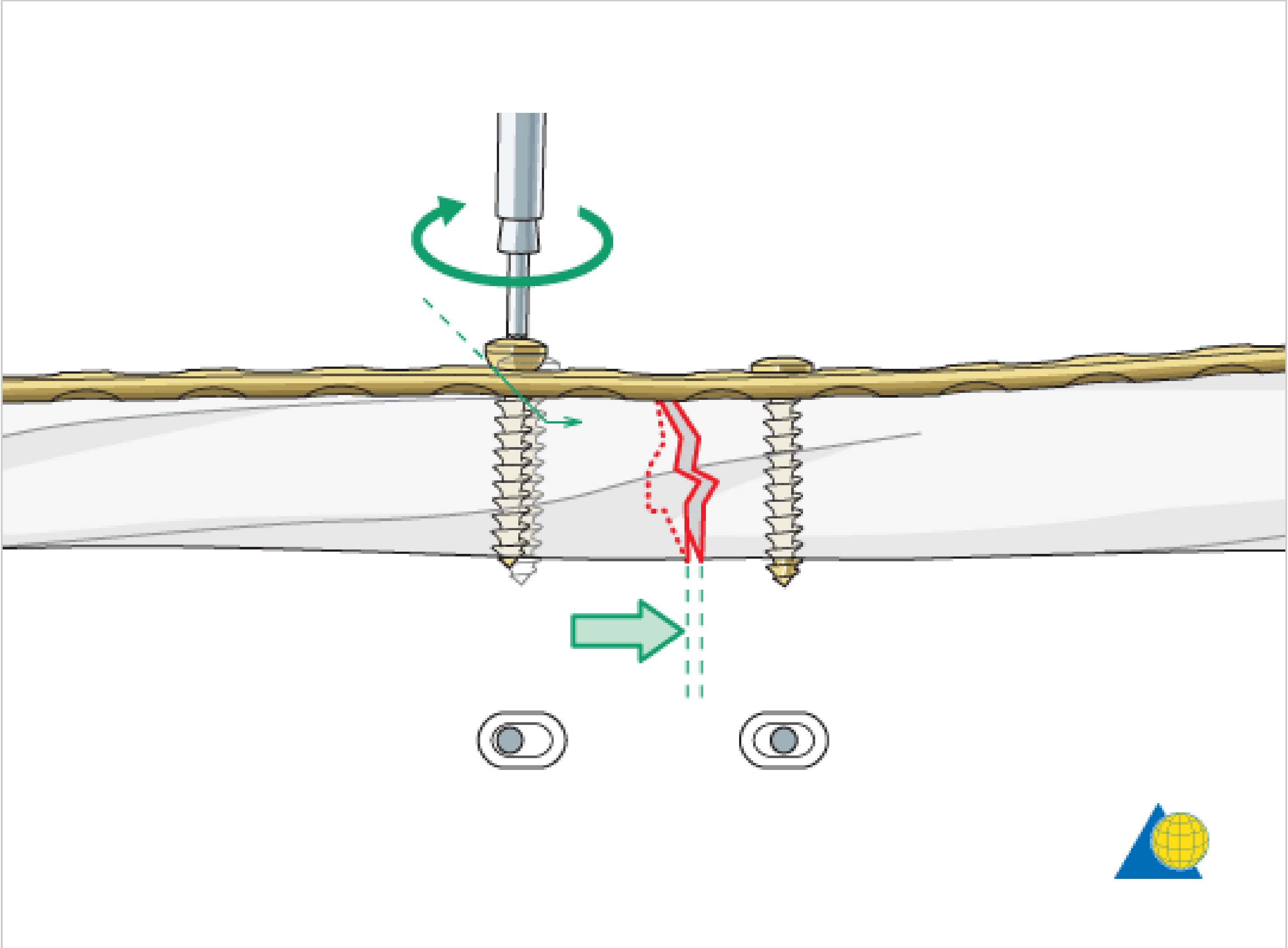
Compression plate



Compression plating provides fixation with absolute stability for two-part fracture patterns, where the bone fragments can be compressed. Compression plating is typically used for simple fracture patterns with low obliquity, where there is insufficient room for a lag screw. The alternative plate fixation technique, used when fragments can not be compressed, is bridge plating.

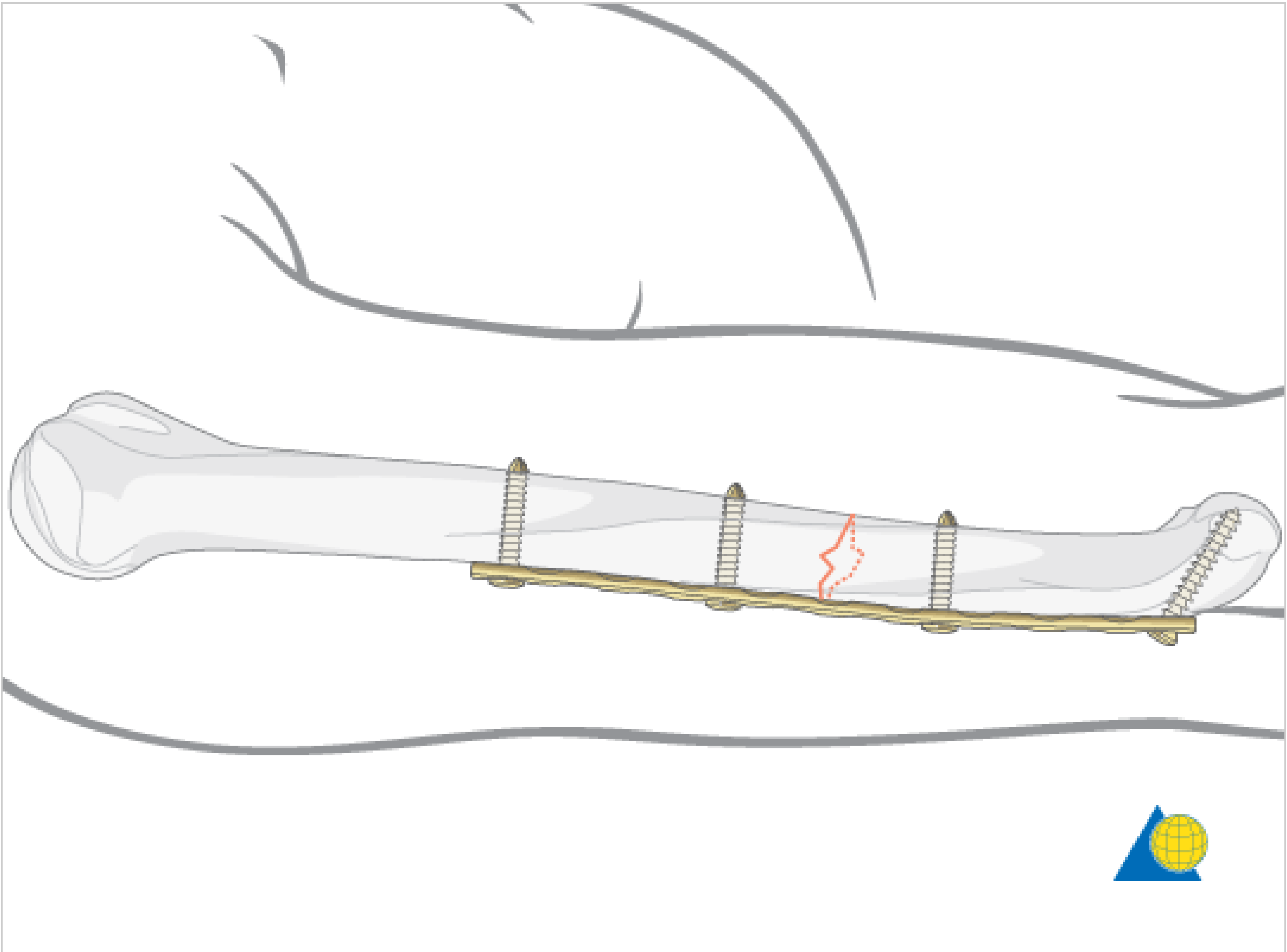
The objective of compression plating is to produce absolute stability, abolishing all interfragmentary motion.

Dynamic compression principle



Compression of the fracture is usually produced by eccentric screw placement at one or more of the dynamic compression plate holes. These holes are shaped like an inclined and transverse cylinder. The screw head slides down the inclined cylinder as it is tightened, the head forcing the plate to move along the bone, thereby compressing the fracture.

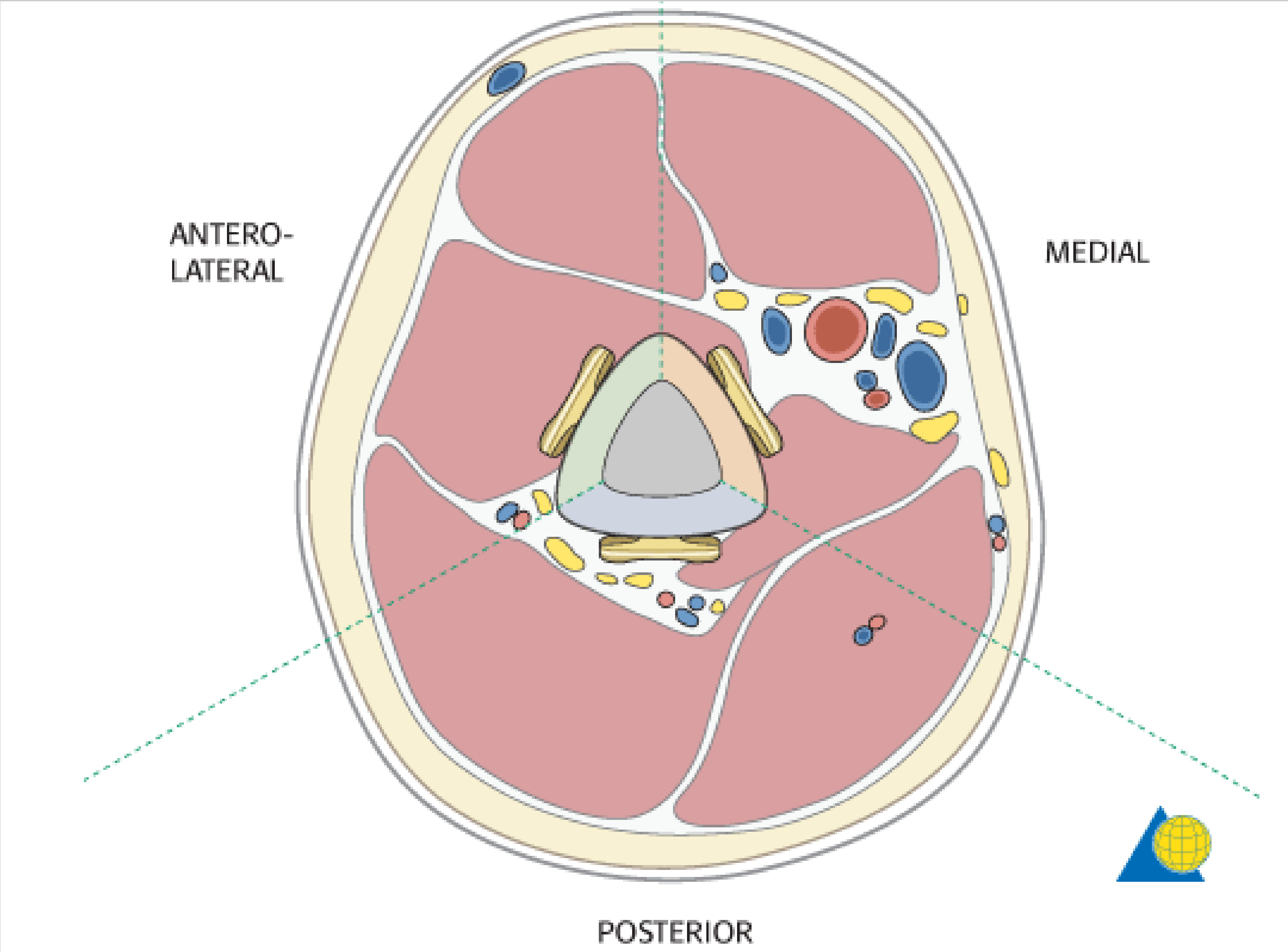
Plate length



It is crucial to use a plate that is long enough on each side of the fracture. Plate length is more important for ensuring stability than is the number of screws.

2. Plate position

Plate location



The humerus has an anterolateral, a posterior, and a medial surface to each of which a plate can be applied. The location of the fracture will determine where the surgeon chooses to apply a plate to the humerus. The position of the plate is selected according to fracture location, and the length of proximal and distal main segments.

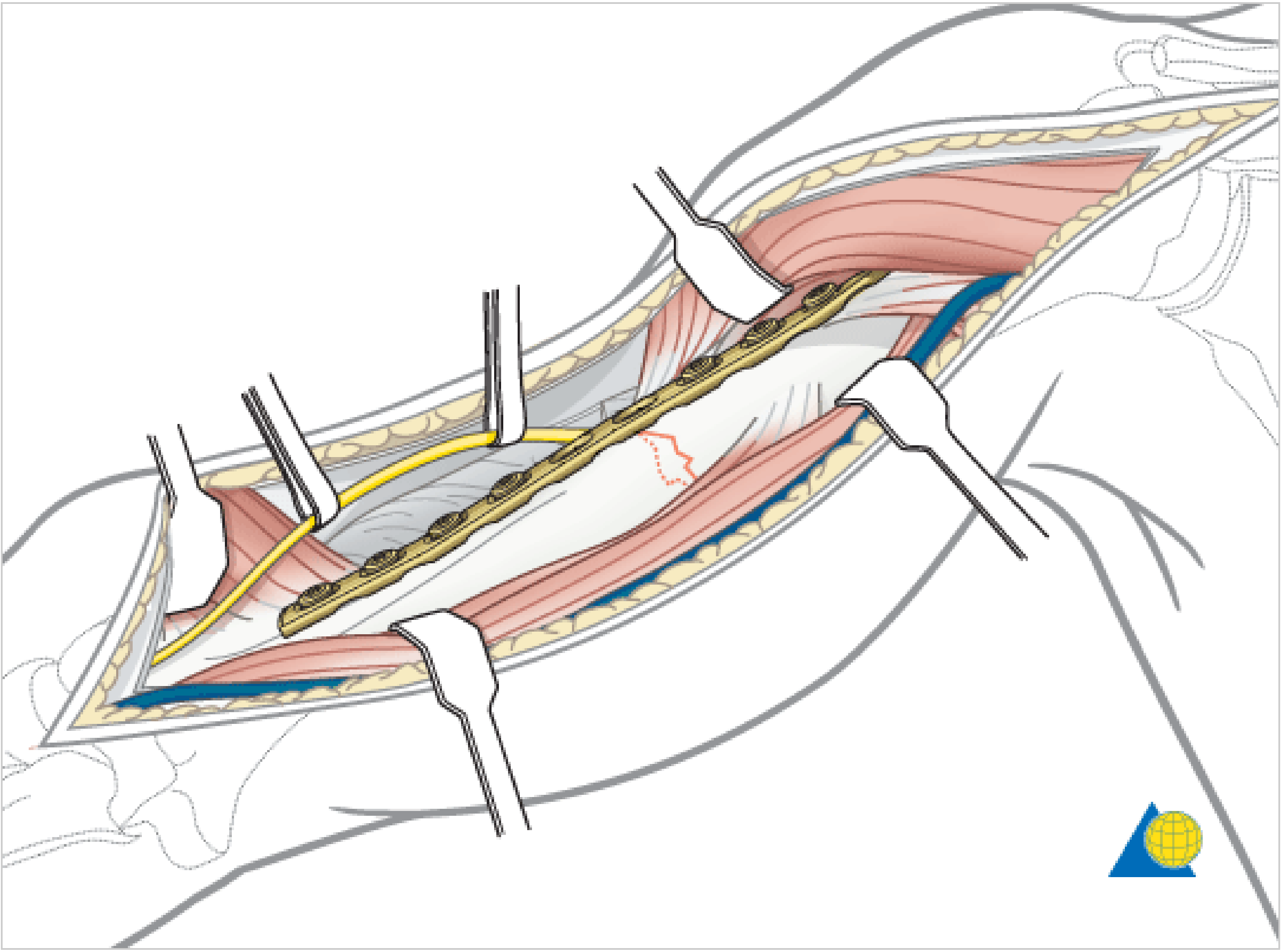
The location should allow sufficient plate length on both proximal and distal segments, with a minimum of 4 holes for each.

An anterolateral plate fits well from very proximally to the distal fifth of the humerus.

The posterior surface is difficult to access proximally and is best suited for middle and distal third fractures. Once a location for the plate has been selected, the surgical approach is determined by that location. For proximal fractures, an anterolateral plate location and anterolateral surgical exposure are usual. For distal fractures, a posterior plate location is preferred. This area can be accessed with either a posterolateral, or a posterior, approach. In the central portion of the humerus, the plate can be applied to the anterolateral, lateral, or posterior surfaces, with the approach dependent on the preferred plate location.

The medial surface is generally reserved for complex reconstructive procedures.

Lateral plating

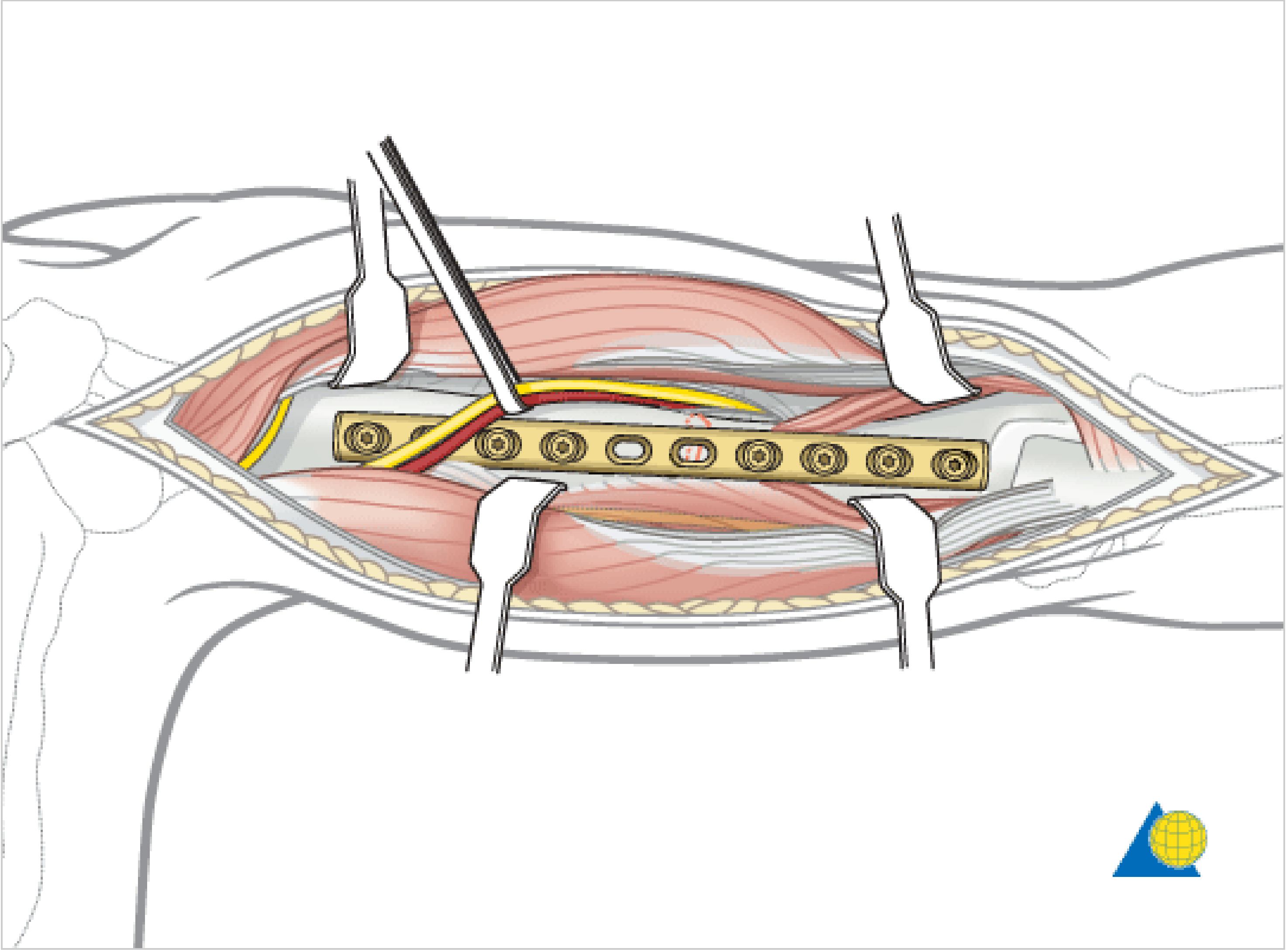


An anterolateral approach is chosen for proximal and middle third fractures, and allows supine patient positioning.

The lateral approach can also be used, particularly if the most proximal part of the humerus need not be exposed.

Distally, the plate may lie deep to the radial nerve.

Posterior plating



A posterior approach will generally be chosen for more distal fractures.

It is important to protect the radial nerve and its accompanying vessels in the spiral groove. Typically, a posterior plate must be placed underneath the radial nerve, to gain proximal bone anchorage.

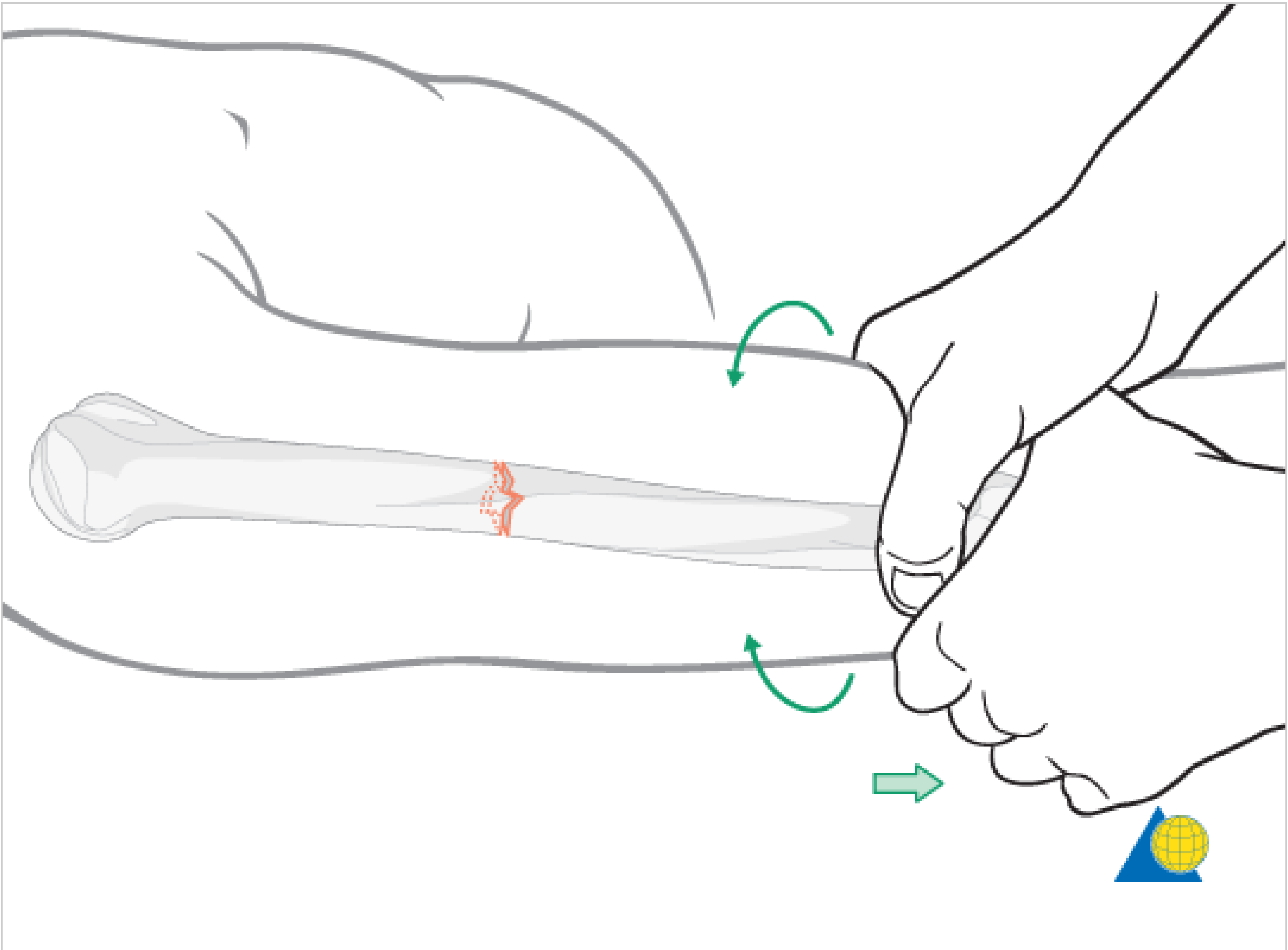
Note

(a) It is possible to extend an anterolateral approach to access the posterior surface of the distal humerus.

(b) It is mandatory to record accurately in the operation record the exact relationship of the radial nerve to the plate - either by a precise drawing, or by recording the plate hole numbers (counted from proximal to distal) where the nerve lies. This will reduce the risk of accidental nerve damage if the plate should ever need to be removed.

3. Reduction

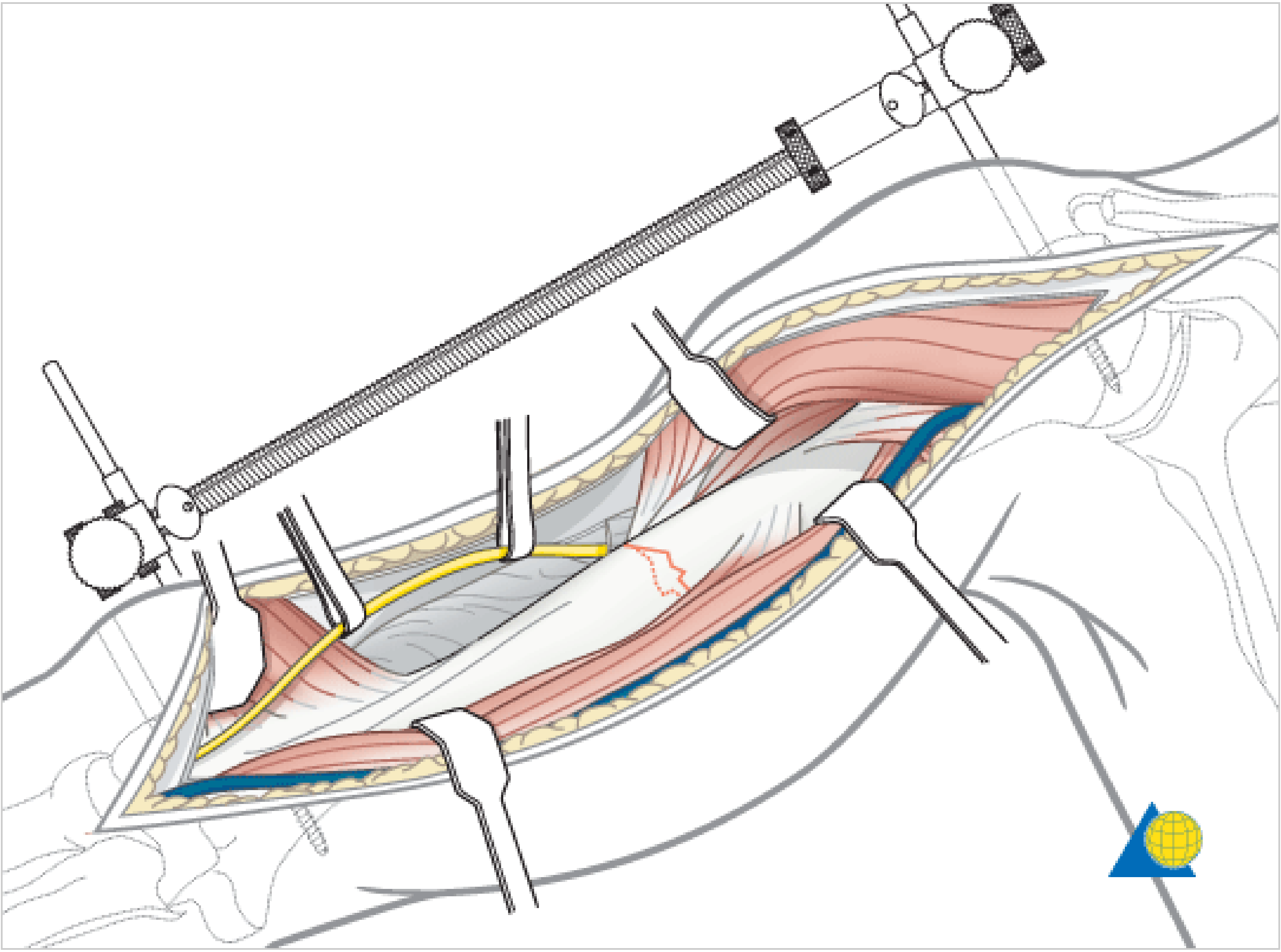
Manual reduction



Reduction should begin with limb realignment. This manipulative reduction takes advantage of soft tissue tension. Traction on the distal humerus restores bone length and tension in the soft tissues, and realigns the axis. Rotation must also be corrected.

Interposed soft tissue may interfere with bone contact. If so, this will need to be cleared by direct exposure, preserving as much soft tissue attachment as possible.

Reduction by external fixator or distractor



Sometimes traction can helpfully be provided by an external fixator, or distractor. The two pins should be inserted outside the planned plate location.

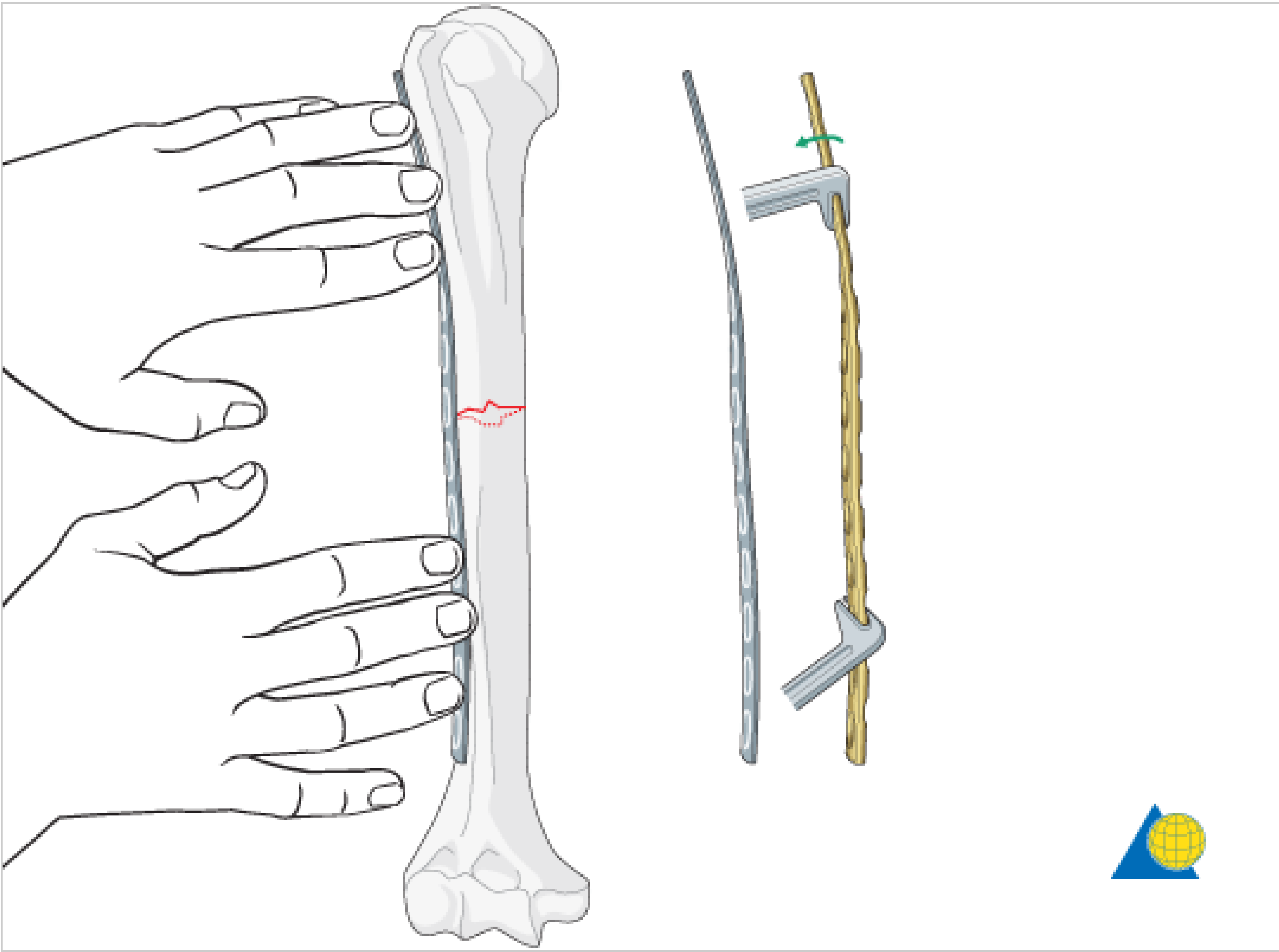
Complete reduction may require additional correction of angulation or rotation. Folded linen bolsters under the fracture often help.

Final reduction

With suitable external supports, tissue tension usually maintains reduction of transverse (A3) fractures. The reduction may need final adjustment after the plate is applied provisionally to one bone fragment. It is important that the reduction be as close to anatomical as possible, in order to provide optimal fracture surface contact.

4. Contouring the plate

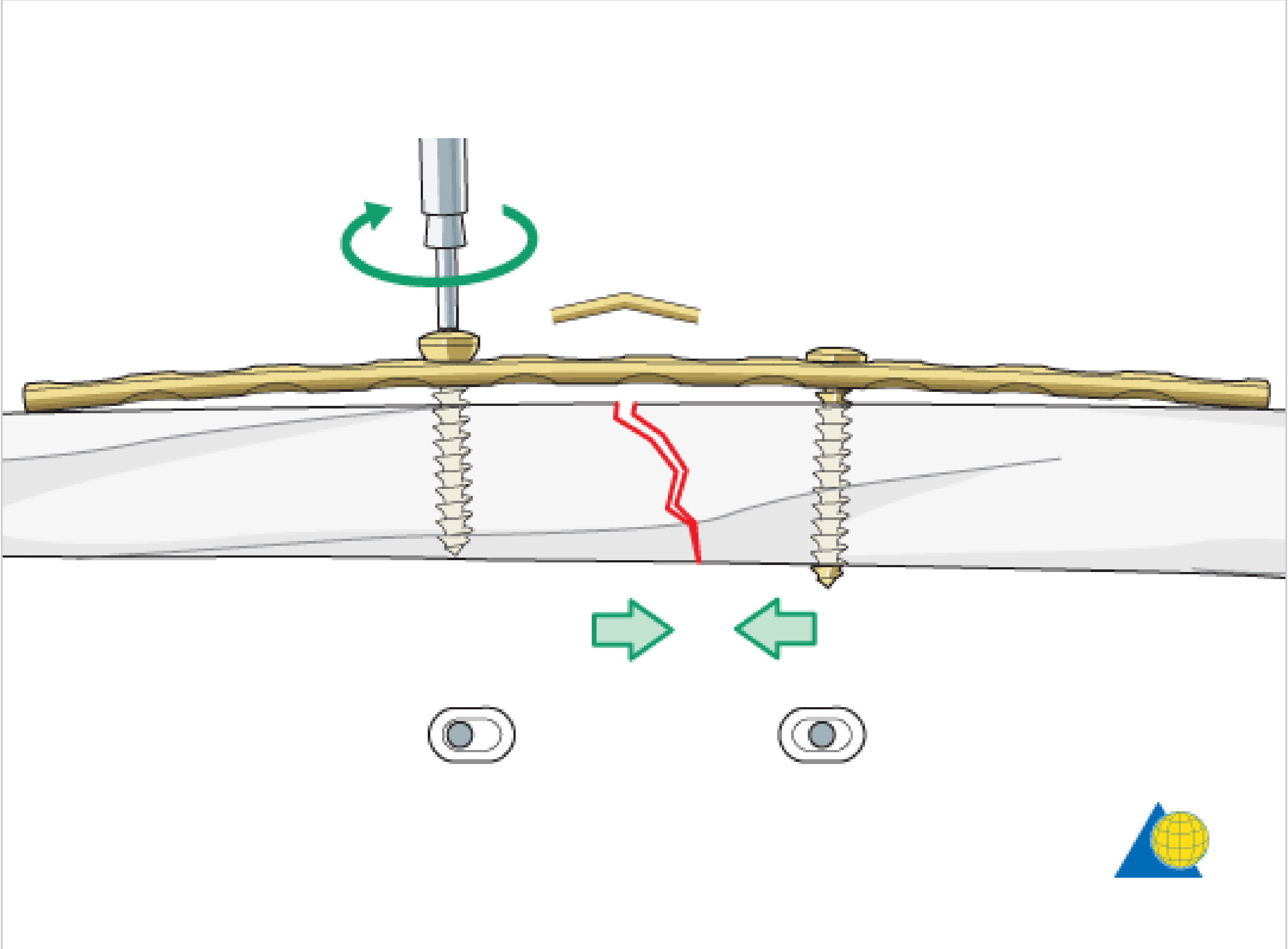
Fitting the plate to the bone



Depending on the planned plate location, some contouring of the plate may be necessary. This is true distally, posteriorly, and also on the anterolateral surface centrally. Sometimes twisting the plate around the shaft of the humerus can provide a better fit, and allow a longer plate.

Contouring is aided by a stable provisional reduction and a malleable template that can easily be shaped to the bone surface. The template is then used as a guide to shaping the plate to the bone.

Overbending the plate

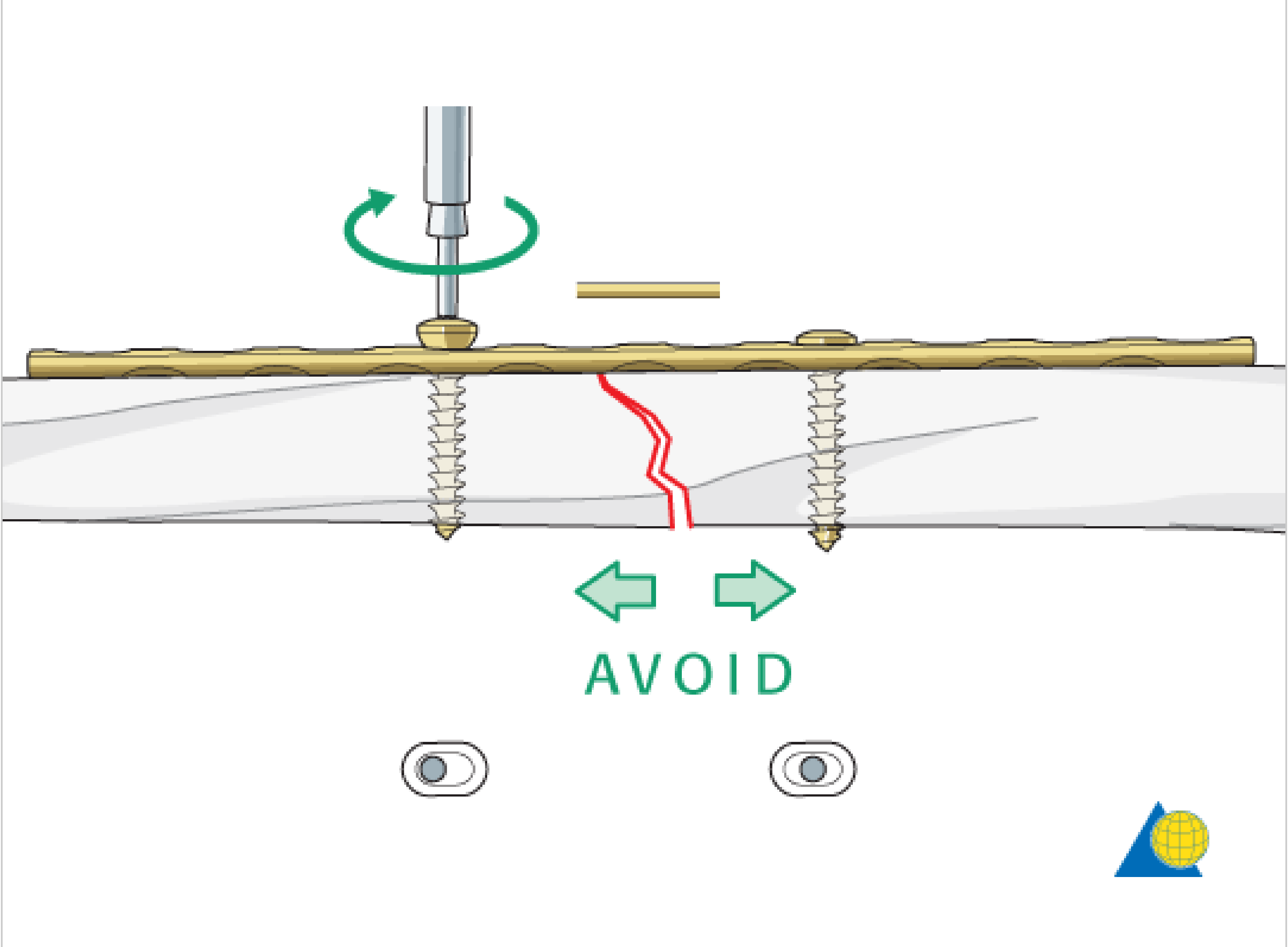


With short oblique and transverse fractures, the plate should be slightly overbent (more convex) so that it does not fit perfectly on the bone. As the eccentrically placed screws are tightened in an overbent plate, the far (trans) cortex is compressed first. With further tightening, the near (cis) cortex also becomes compressed.

Such short, convex “overbends” can be made with the handheld bending pliers or bending irons. The overbend should lie directly over the fracture line.

When the fracture is oblique enough, one should insert a lag screw through the plate. Slight overbending still helps to keep the fracture surfaces together, and the lag screw increases stability.

Pitfall: Fracture opening opposite plate



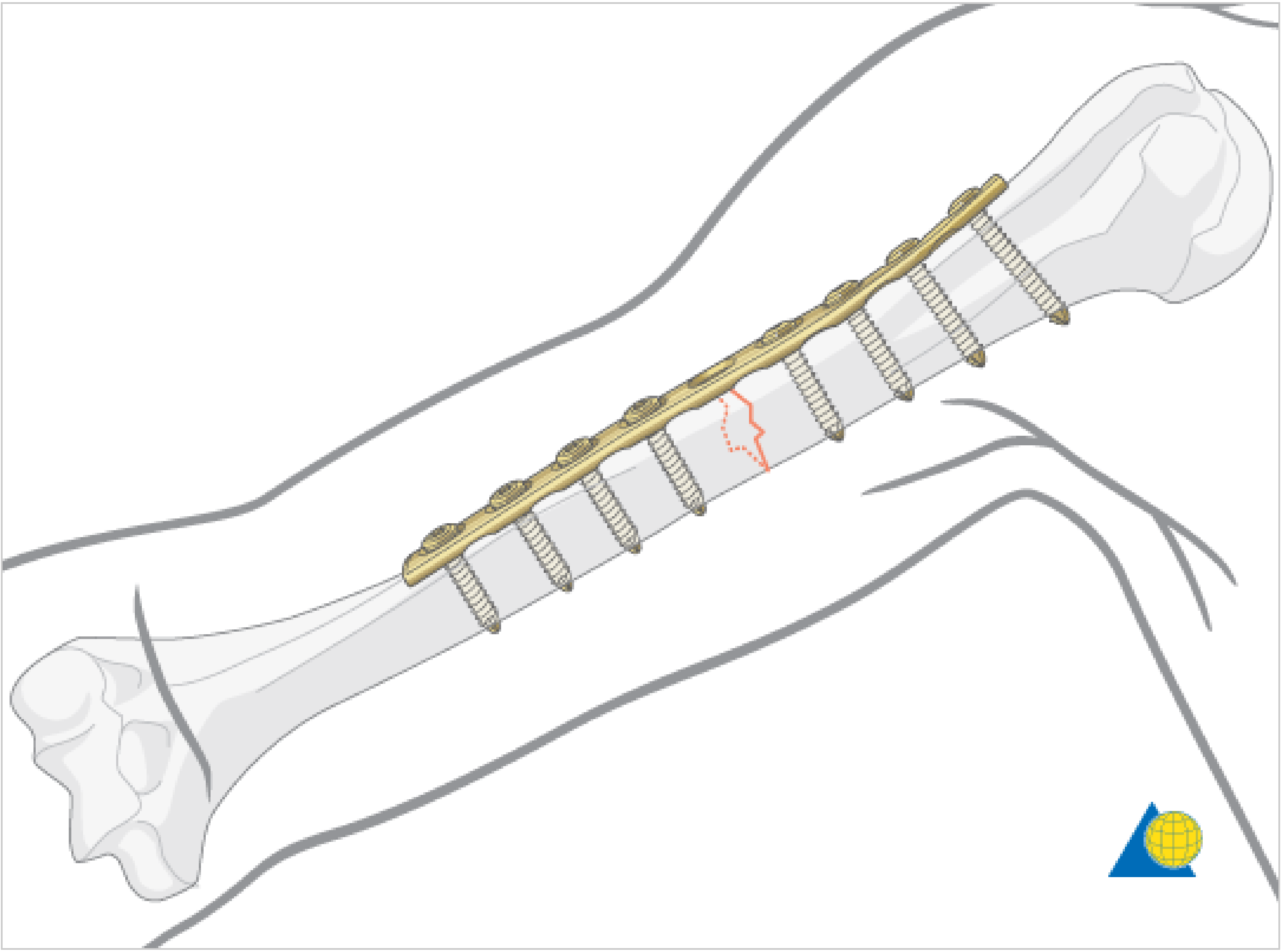
When a transverse or short oblique fracture is compressed with a plate, this eccentric plate compresses the bone under the plate, but causes gapping on the side opposite the plate (trans cortex). This gapping, and its consequent associated micromotion, can be prevented by overbending the plate to achieve compression of the opposite side first.

An alternative solution can be to insert a lag screw through the plate, across the fracture plane, as discussed below. This technique will also prevent gapping and micromotion.

In single plane fractures, such as this example, micromotion results in excessive strain of the healing tissues at the fracture site and also risks plate fatigue failure if union is slow.

5. Plate fixation

Application of the plate

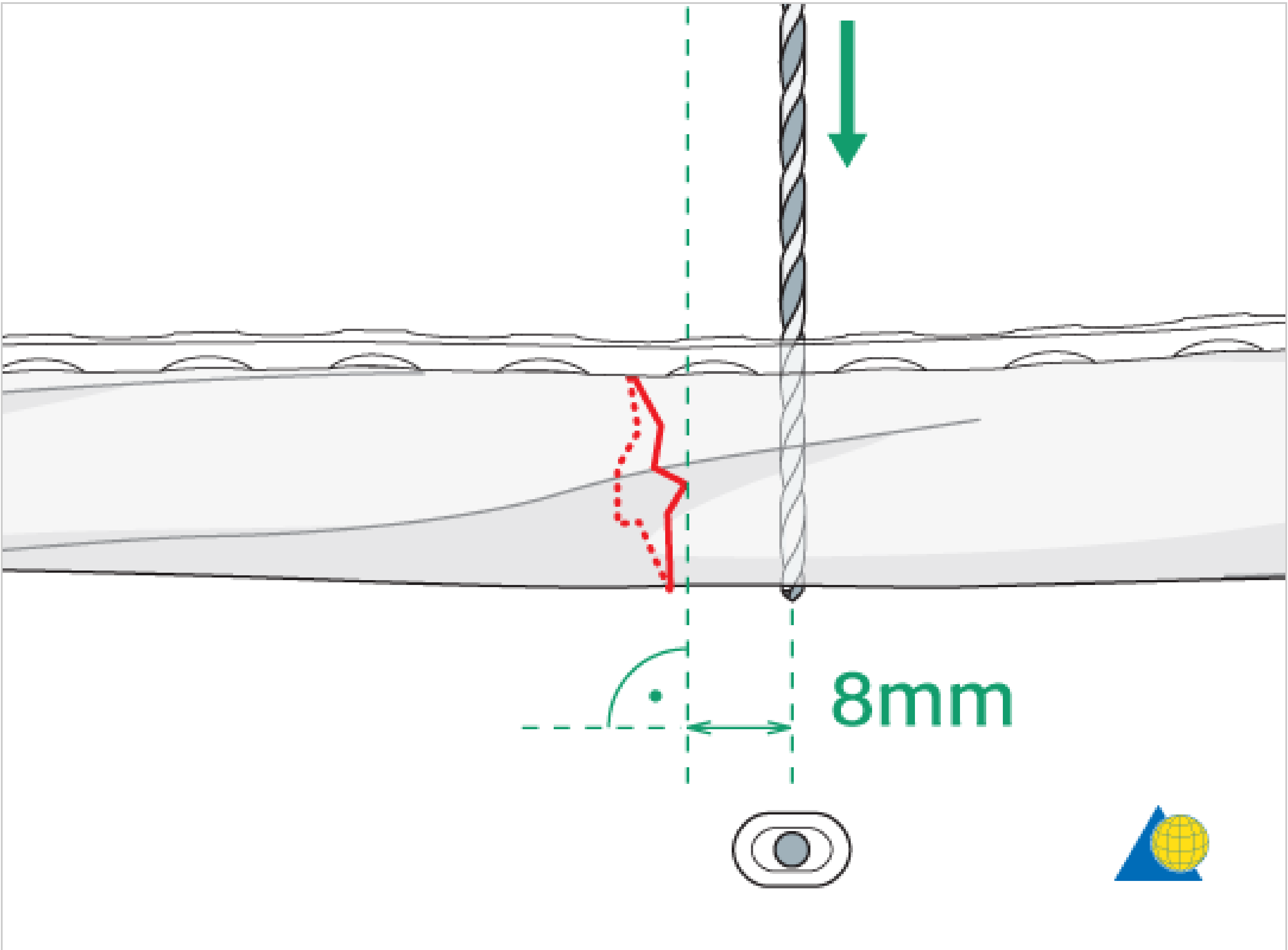


No periosteal stripping should be done for plate fixation. However, there must be adequate soft tissue exposure to provide an appropriate area for the plate.

The plate should be positioned over the fracture so that at least four holes can be used in each proximal and distal pieces. Some compromise may be necessary for very proximal or distal fractures.

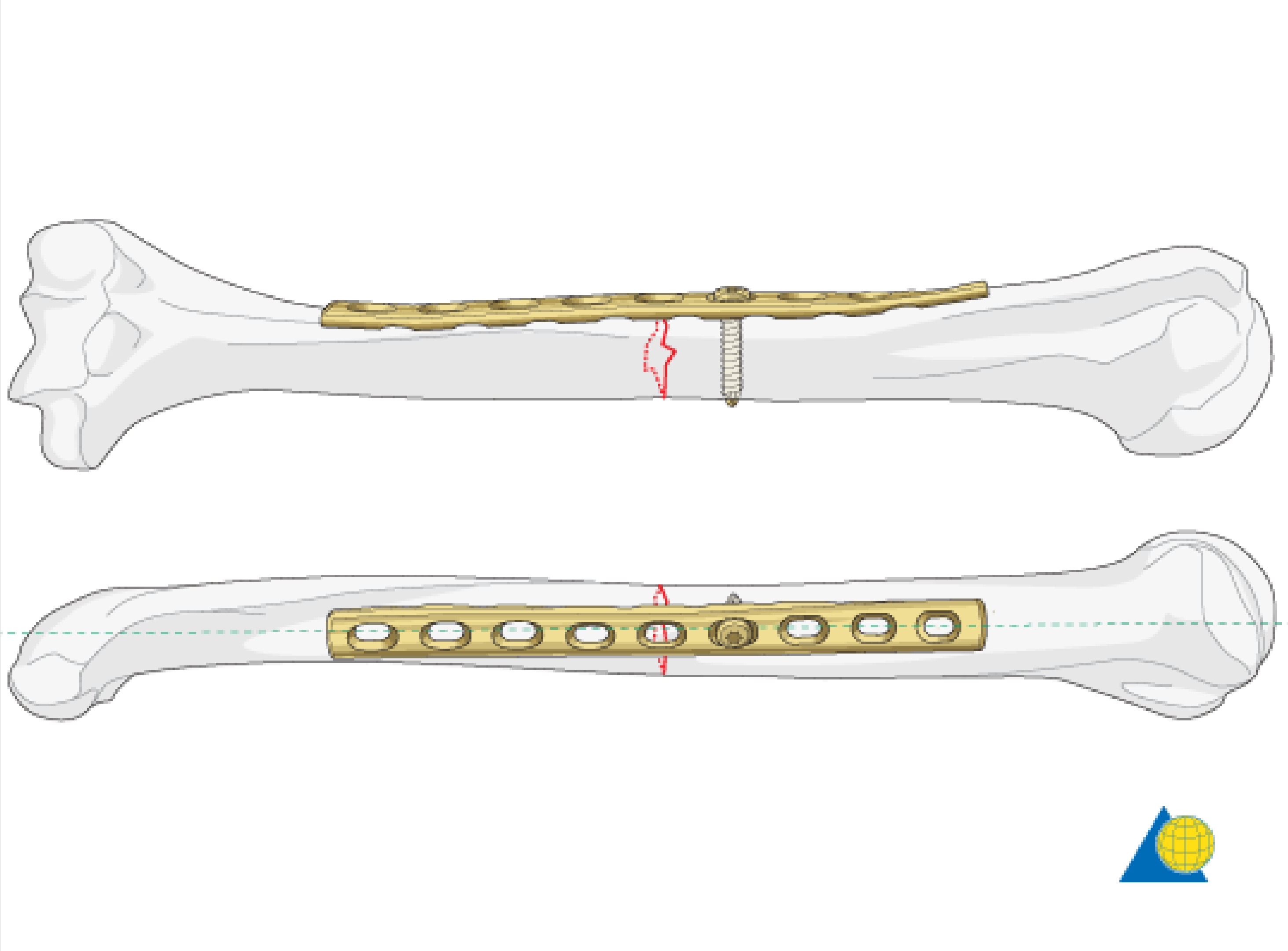
It is often helpful to hold the plate to the bone with one well-placed screw in order to confirm that it is contoured correctly.

Drilling for the first screw



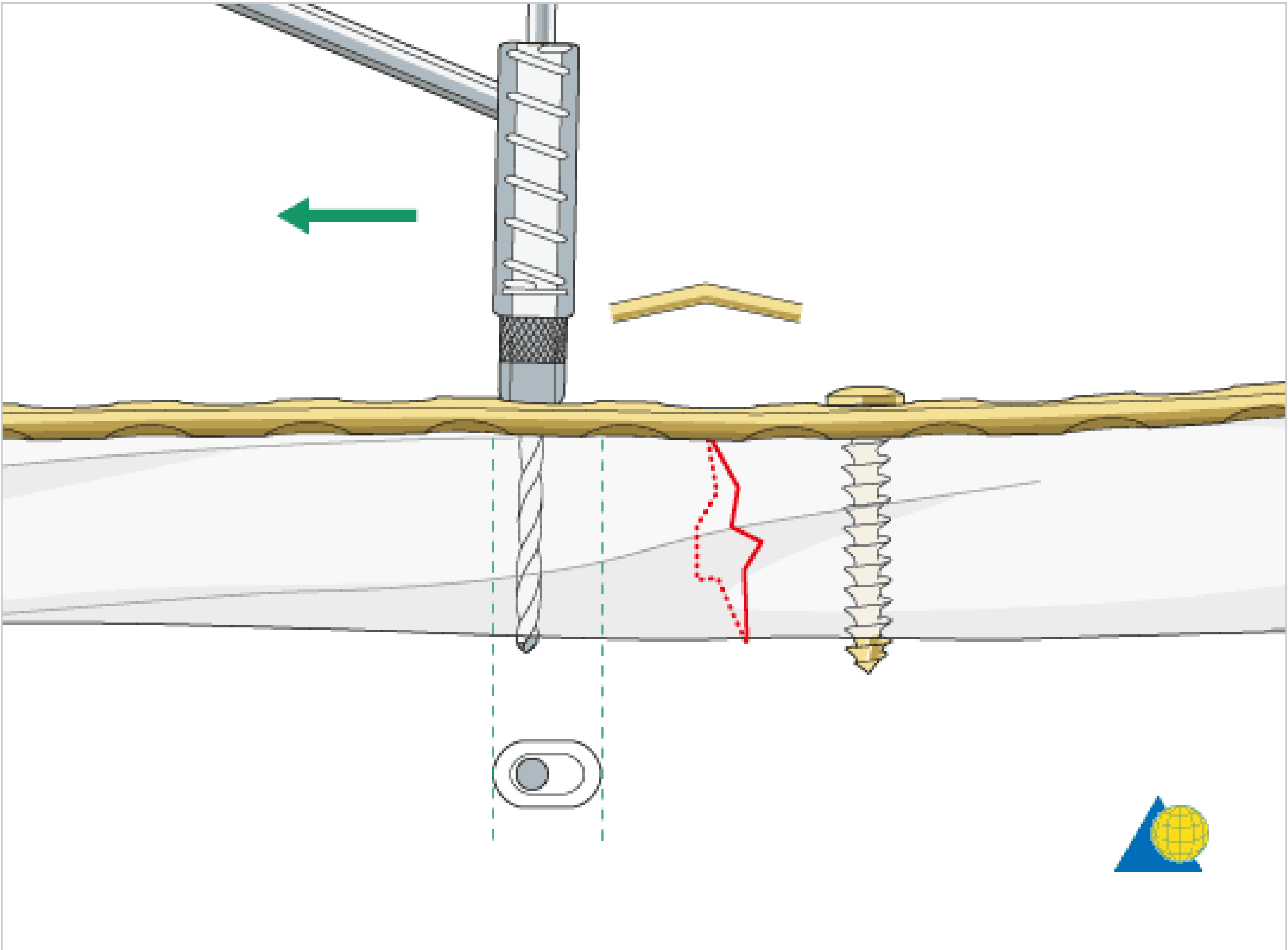
Remembering the desired plate position, drill a pilot hole approximately 8 mm away from the fracture. Its depth should be measured and then the thickness of the plate added to determine screw length. Its depth can alternatively be measured through the plate. Now tap if non-selftapping screws will be used.

Application of the plate with a first screw



Attach the plate with one screw to the pre-drilled fragment. Do not tighten the screw completely. Check plate fit and alignment, and the fracture reduction. If satisfactory, proceed to drill the other fragment.

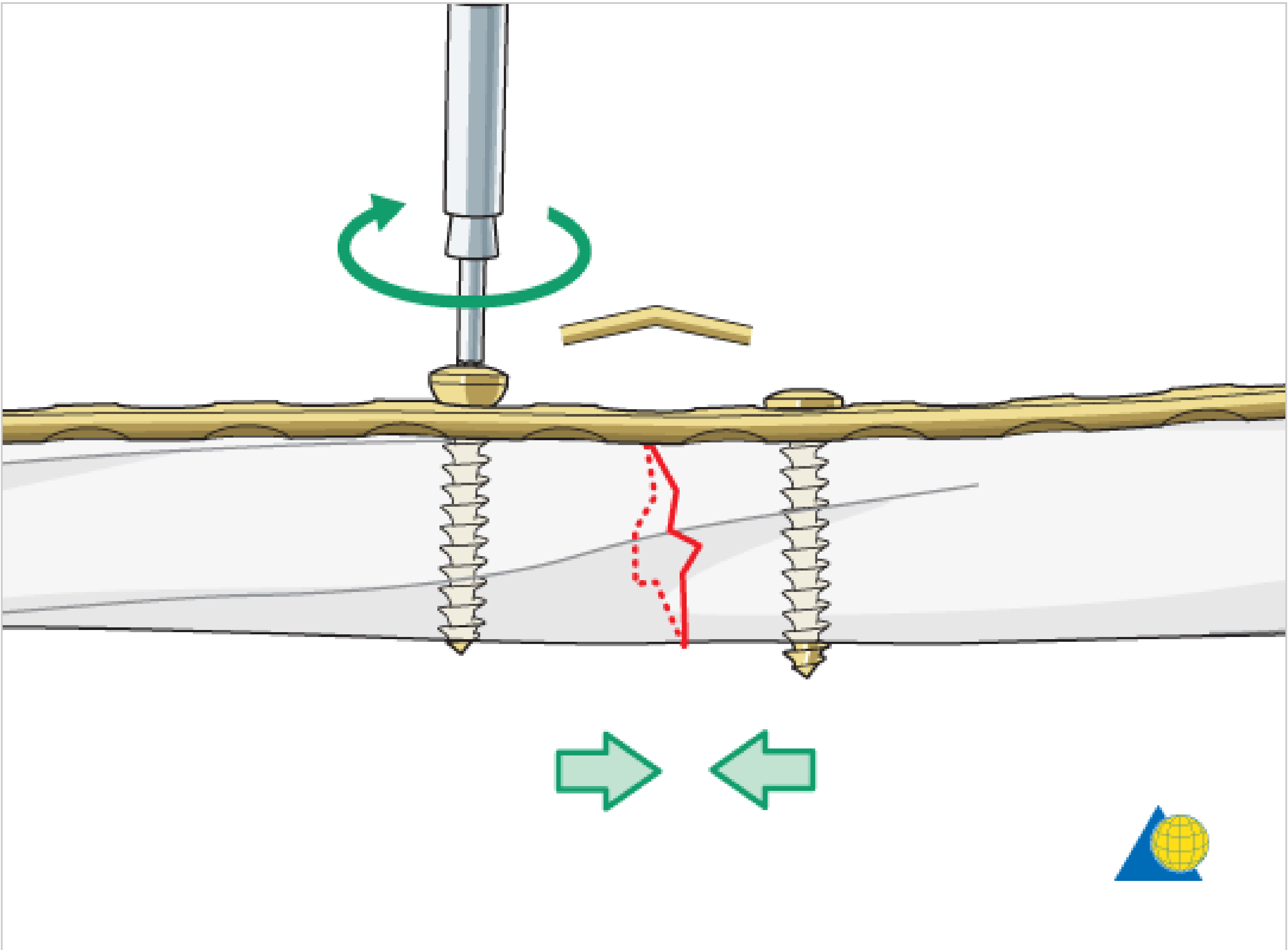
Insert a second screw eccentrically



A second screw is inserted eccentrically into the other fragment, near the fracture. Tightening the eccentrically placed screw moves the plate, thereby compressing the fracture.

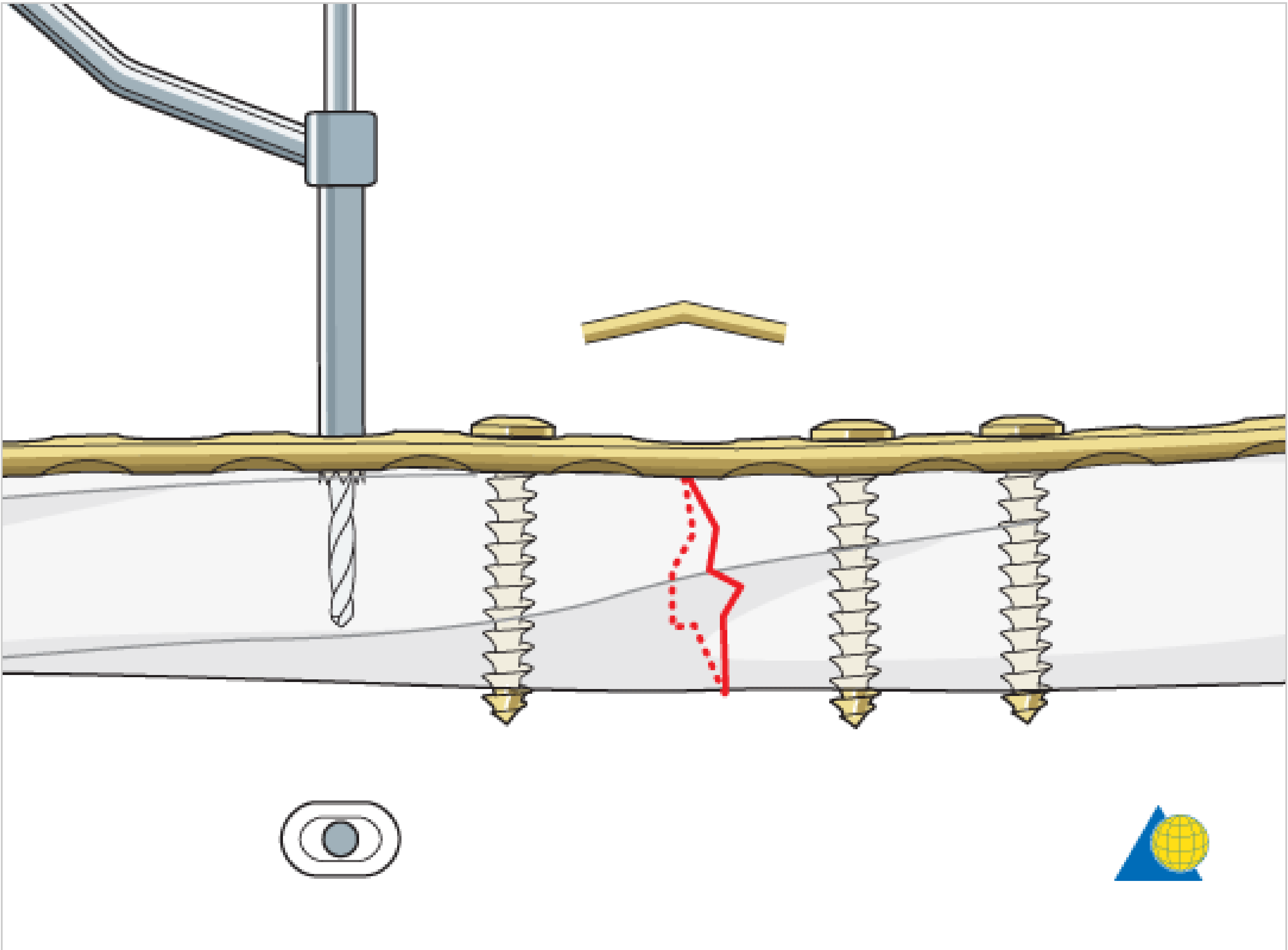
Confirm that the fracture surfaces are reduced, and that both ends of the plate fit satisfactorily.

Tighten screws to compress fracture



Tighten both screws alternately, watching carefully to see that the reduction is maintained and compressed satisfactorily.

Finish screw insertion



The remaining screws are then inserted. Screws closest to the fracture site are inserted first.

The humerus has a thin cortex and may be osteoporotic, in which case it may be safer to fill all the screw holes. In the past, the broad plate has been recommended to allow staggered screw holes. This is not necessary, but the screws should be inserted divergently to achieve this effect on the far cortex.

Appendix

Note

Beware of harming the radial nerve

Shortcuts

All Preparations

All Approaches

All Reductions & Fixations

Decision support

OTD Evidence report: Timing of wound debridement in open fractures

Further reading

Principles of diaphyseal fracture management

Principles of surgical reduction

Biomechanical principles: Absolute stability

Decision making in severe soft-tissue trauma