Ventral plating of the humerus using minimally invasive plate osteosynthesis (MIPO) techniques

**Rationale** Conventional open plate osteosynthesis of the humerus risks damage to the radial nerve; nailing may cause problems with the shoulder joint or the elbow; and there are fractures that are too complex to be fixed by intramedullary (IM) nailing.

The ventral aspect of the humerus offers an approach that does not interfere with nerves or major blood vessels. Percutaneous plating is therefore feasible, and MIPO allows bridging of complex fractures. So far, three authors have reported on ventral humeral plating with a total of 19 patients [1–3].

**Technique** Two skin incisions are necessary: the proximal one is a deltopectoral approach, or part of one, and the distal incision is done about 3 cm long over the biceps tendon. The sensory branch of the musculocutaneous nerve has to be preserved in the distal wound. Once the bone is prepared in both incisions, tunnelling of the ventral side of the humeral shaft with close contact to the bone is cautiously carried out. This is a smooth and easy manoeuvre, the deltoid insertion being the only structure giving some resistance.

Fracture reduction has been carried out with the plate in situ, eventually even after provisory fixation of the plate to one or both main fragments. The use of an arm-positioning instrument eases fracture reduction, but an external frame may be advantageous.

Plate fixation itself follows the rules of MIPO. A locking compression plate (LCP) is the standard fixation device for shaft fractures. Long PHILOS plates are used in fractures that extend proximally into the humeral head.

**Results** The age of the patients in a first series of 28 patients varied between 38 and 84 years. So far, 17 patients have been followed for at least 6 months. Ten long PHILOS plates; four LCPs 4.5, three LCPs 3.5, and one tibial metaphyseal plate were used. Two out of 17 fractures have not healed: one pseudarthrosis is still stable with an intact plate and does not need further treatment; in the other patient a pseudarthrosis needed reoperation. One patient was lost during follow-up. There were no nerve injuries and no infections or other complications intra- or postoperatively.
Fig 1a–d
An 82-year-old patient with a closed acute fracture, Müller AO Classification 12-A1, and no nerve injury (a). One small incision is placed over the deltopectoral groove, a second one over the distal biceps tendon (b). The LCP is introduced in a caudal direction (c). Healed fracture after 4 months (d).
Conclusions  MIPO of even complex humeral shaft fractures without exposure of the radial nerve can be done safely if the plate is placed anteriorly. Twisted plates would facilitate placement and reduction. More experience, especially regarding reduction technique, is still needed.

Bibliography:
Fig 3a–d
Same patient as in Fig 2. Range of motion 11 months after injury.

Fig 4a–c
A 39-year-old patient with a closed acute 12-C1 fracture, and no nerve injury (a). MIPO with PHILOS and follow-up after 14 weeks (b,c).