Open Reduction and Internal Fixation of Proximal Humerus Fractures with a Cannulated Blade Plate

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Abstract
Objective
Internal fixation of proximal humerus fractures with an implant assuring rotational and angular stability to restore form and function of the glenohumeral joint.

Indications
Proximal humerus fractures: two- and three-part fractures, meta- and diaphyseal fractures of the proximal second fifth.

Contraindications
Comminuted fractures of the humeral head. Proximal humerus fractures in children.

Surgical Technique
Anterior approach. Blunt dissection of the deltopectoral interval, retracting the cephalic vein medially. Judicious exposure of the fracture site and reduction of the fracture. A 90° blade plate opened up to 110–120° is inserted from anterolateral immediately proximal to or through the subcapital fracture gap. The blade of the blade plate is introduced into the proximal half of the humeral head. In the presence of an avulsion of the greater tuberosity, a wire cerclage is added.

Results
Between June 1998 and December 1999, we treated 20 patients (eight men, twelve women, age 65–92 years) and assessed them prospectively. All fractures were closed (AO types 11-A3 n = 8, 11-B1 n = 5, 11-B2 n = 3, 11-B3 n = 1, and 11-C2 n = 3). Loosening of plates was seen in three patients and a blade perforation in one, all requiring a revision (revision with plate blade twice, shoulder hemiarthroplasty once, early implant removal once). Five patients passed away, and two were too old to undergo a follow-up examination. The Constant score in 13 patients performed after 8 (7–10) months reached 62/100 (opposite shoulder 92/100). This corresponds to a satisfactory outcome.

Key Words
Proximal humerus fracture · Internal fixation · 90° cannulated blade plate · Elderly patient

Operat Orthop Traumatol 2002;14:290–8
Orthop Traumatol 2002;10:268–76
DOI 10.1007/s00065-002-1055-7
**Introductory Remarks**
Proximal humerus fractures are the most frequent injuries seen in the older population [12]. At the first glance, their treatment seems unproblematic since a reduced function of the glenohumeral joint of the non-weight-bearing limb may be compensated by movements of scapula and trunk. In the presence of stable impaction and minor fragment displacement, these fractures can be treated conservatively. However, unstable and displaced fractures must be treated surgically. Although the indication for plate fixation is well established [2, 7], internal fixations using less implant material are gaining increasing acceptance [3, 5, 6, 10] given their biological advantages. Both surgical approaches rarely allow an anatomic reduction and sufficient mechanical stability at the same time [7].

The cannulated 90° blade plate permits rotational and angular stability thanks to its special blade geometry. Round holes in the upper part of the plate allow introduction of an additional cancellous screw into the head fragment thus increasing the stability of internal fixation. We have changed, however, the 90° angle and open it up to 110–120° facilitating the placement of the blade in the mid part of the humeral head known for its increased density of cancellous bone. The resulting increased stability permits to counteract the forces that occur during the functional aftercare. In turn, this leads to a satisfactory outcome in the mostly geriatric patient population and meets their demands for activities of daily living.

**Surgical Principles and Objective**
Sufficient angular and rotational stability of proximal humerus fractures allowing early exercises. Through an extended anterior approach exposure of the zone of fracture without major dissection. After reduction of the fracture, the blade plate that had been opened up to 110–120° is inserted proximal to or through the subcapital fracture gap. Positioning of the blade in the upper half of the humeral head. If needed, wire cerclage of a displaced greater tuberosity fragment. Restoration of a pain-free shoulder function thanks to early mobilization.

**Advantages**
- Indirect reduction without extensive exposure of the fragments sparing as much as possible the rotator cuff and the blood supply to the fragments.
- Angular and rotational stability of internal fixation with anchorage of the blade in the dense cancellous bone of the mid part of the humeral head (Figure 1).
- Neutralization of forces generated by forward elevation, abduction, and rotation allowing early mobilization even in older patients with osteoporosis.
- Snug fit of plate to bone not causing any soft tissue irritation.
- Distal transfer of the blade’s entry point reduces risk of implant-induced impingement.
- Short period of postoperative positioning of arm in a Gilchrist sling for pain relief.
- Early postoperative active and passive exercises (CPM).

**Disadvantages**
- In the presence of additional cerclage wires: the combination of two metals (titanium and steel) may lead to osteolysis.
- Relatively high cost of implant.
- Opening of the 90° blade plate as supplied by the manufacturer to 110–120°.

**Indications**
- Proximal humerus: two- and three-part fractures, meta- and diaphyseal shaft fractures in the second fifth.
- Intraarticular fractures of AO types C1 and C2 [8] are relative indications.

**Contraindications**
- Comminuted humeral head fractures (C3).
- Fractures in children.